Recognising and supporting children under three as problem solvers

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Abstract

This study provides evidence showing the ability of ten children under three years of age to solve problems in managing their worlds. It analyses a series of observations made over a ten-month period of these children 'at work' in their nurseries. The analysis is set against current research and takes account of the support provided to the children by their key person – the adult who acts as their main carer in the nursery setting.
The study details the rationale for using nurseries as a research location; it proposes a working definition of 'problem solving'; it describes the ethical framework used in governing the conduct and use of the observations, and the analytical framework to which the observations are subjected.

The study shows that the use and development of the children's problem solving capability in their nurseries is influenced by organisational factors and that adult support is emotional as well as practical. It also raises several issues: practitioners' perceptions of constraints placed by the current Early Years Foundation Stage curriculum, over-reliance on some support methods to the exclusion of others, attitudes to risk taking, acknowledging children's ownership of their problems and the use of failure as well as success to support their learning. The study highlights several areas worthy of further research, including the use of treasure baskets to develop problem solving skills, recognition of children's preferred patterns of thinking and an examination of what some practitioners involved in the study termed 'intuitive support'.

Arising from this study is the question 'so, what happens next?' I suggest that more discussion is required in early years settings about the use of problem solving as a vehicle for very young's children's learning. Furthermore, practitioners' roles in developing children's cognitive skills and supporting their emotional needs must be part of this discussion.

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Many thanks also to the many early years practitioners who generously gave their time to my study and the support of colleagues.

I have been privileged to get to know ten children over a period of ten months. I would like to thank them for allowing me to observe their remarkable problem solving capabilities.

To study as a mature student has been a joy. My student years started for me in my forties with a first degree from the Open University leading to a masters degree and, as I had 'more to say and write', entry to the EdD programme at the University of Sheffield. Throughout this period, my family have given me unconditional support.

To my wonderful husband Richard, our son Edward and our daughter Harriet, I offer grateful thanks.

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Glossary and Acronyms

DCSF	Department of Children, Schools and Families
DfES	Department for Education and Skills
EYFS	Early Years Foundation Stage
NCTM	National Council for the Teaching of Mathematics
PSRN	Problem solving, Reasoning and Numeracy

Introduction

The purpose of my study is to explore the abilities of very young children as problem solvers. Through the observation of ten children under the age of three my study uncovers the intricacies of their thinking and actions, revealing their competencies as problem solvers.

Location of main study

My main study is based in three early years group care settings (nurseries) located in Oxford and Bedfordshire, England. It involves ten children under the age of three, nine childcare practitioners and three nursery managers.

The research questions

Drawing on observations made throughout the main study period my first research question asks:

- In their nursery settings what are the main ways children under three use to solve problems during their play?

Influenced by Nutbrown's (1996) view that 'just seeing, just understanding is not enough' (p. 45) my study also examines how very young children's problem solving within a nursery environment is supported. It focuses on the role of the children's main carer, their key person. The appointment of a key person is a legal requirement enshrined in the Early Years Foundation Stage (EYFS) (DCSF, 2008a), where the role is described as:

> The named member of staff assigned to an individual child to support their development and act as a key point of contact with that child's parents. (p. 52)

My second research question focuses on the support offered by the children's key person and asks:

- In a nursery setting how do the children's main carers - their key person – support their problem solving during periods of play?

The structure of the thesis

Chapter one sets the scene by outlining the influences on my view of child development and on my positionality. It then discusses the rationale behind my research, why problem solving was chosen as its focus and the benefits of locating the study in nursery settings.

Chapter two explores the theoretical framework of the competent infant perspective of development (Goswami, 2010; Gopnik, Meltzoff and Kuhl, 1999) in the light of the concept of the child as an active learner (Piaget, 1952).

Chapter three is a review of relevant literature drawn from established publications and current journal research papers in the fields of cognitive psychology and early childhood education. The literature review is divided into two parts. The first section highlights research findings that illustrate the role of play in children's learning, its link with the development of children's problem solving skills and the cognitive processes that very young children use when given problem solving tasks. The second part discusses the multi-faceted role of the children's key person, as defined by Elfer, Goldschmied and Selleck (2003), which encompasses the emotional support provided by early years practitioners for the children in their care. The chapter goes on to review the role of the adult as a 'knowledgeable other' (Vygotsky, 1978, p. 89) with reference to the use of sustained shared thinking (Siraj-Blatchford, Muttock, Gilden and Bell, 2002) as a proactive approach to supporting young children's learning.

Chapter four examines methodology and research methods. First, the chapter explores research methodology and the rationale for using an ethnographic approach to case studies as a research method, alongside the benefits of using observation as a means of collecting data. The second section is a discussion of ethical considerations. It gives examples of my approach to ethical issues and acknowledges the importance of being a respectful researcher. Finally, I discuss the creation of an analytical

framework and how it was applied to decoding and analysing the children's approaches to problem solving and the ways in which their key person supported these.

Chapter five contains the analysis and findings of my study. Drawing on the observations taken during the main study it identifies and discusses the methods most frequently used by the children when solving problems, illustrating these methods with descriptions of the children 'at work' problem solving. Chapter five also highlights examples of the types of support provided by the children's main carer - their key person (DCSF, 2008a).

Chapter six is a reflective chapter and considers the scope of my study and its contribution to research. The chapter goes on to highlight areas that warrant further study and discussion in the context of problem solving. These include:

- The use of treasure baskets to promote problem solving
- Utilising children's patterns of learning to support their problem solving
- Defining what constitutes adult 'intuitive' support of problem solving
- Early years practitioners' perceptions of constraints placed by the EYFS (DCSF, 2008a) with regard to problem solving
- Over-reliance on some methods of adult support within the sustained shared thinking framework
- Attitudes to risk taking in young children's problem solving behaviour

In addition, organisational issues that impact on problem solving are considered, including:

- How information about children's problem solving is passed on when children are transferred to a new key person
- Access to outdoor areas for children under three
- The potential benefits for children under three of mixed aged grouping in nurseries

The concluding section reaffirms the importance of problem solving and of the need for it to be discussed by early years practitioners as a vehicle for very young children's learning (Britz, 1993). Furthermore, this discussion needs to include not only how problem solving is supported as a series of cognitive skills but also in terms of children's learning dispositions (Claxton and Carr, 2004) and emotional needs.

Chapter One

Research context and rationale

Research context

Major influences on my thinking about the abilities of very young children and how best to support their learning

Early years literature has long emphasised the value of a safe learning environment which enables children to play in ways that promote their creative, investigative and problem-solving abilities, while meeting their emotional needs (Evangelou, Sylva and Kyriacou, 2009; Nutbrown and Page, 2008; Moyles, 2005; Manning-Morton and Thorp, 2003; David, Goouch, Powell and Abbott, 2003; Whitebread, 1996; Isaacs, 1926).

In addition, the review of research into the innate and learnt capabilities of babies and very young children carried out by Gopnik *et al* (1999) provides convincing evidence that children under three know and learn more about the world 'than we could ever have imagined' (p. vi).

At the outset of my study the above points of reference and studies such as Selleck and Elfer (1997) confirmed my views about the individual competencies of very young children. Further reading (David *et al*, 2003) and my involvement as a teacher based in a Children's Centre in the implementation of *Birth to Three Matters* (DfES, 2003) reinforced my view that further discussion was required about the benefits of the adoption of a holistic approach to child development. In addition, I became aware of the extent to which cognition and social and emotional development have been, as Greene (1999) points out, seen as separate, rather than interdependent realms of development.

Later participation in a post-graduate level of study triggered further reading and a re-introduction to the competent-infant perspective of development (Gopnik *et al*, 1999). This built on my previous teacher training which was dominated by Piagetian theory and the concept of the child as an active learner. Piagetian theory, in spite of its limitations (Bremner, 2011; Donaldson, 2006; Bremner, Slater and Butterworth, 1997), still underpins my understanding of how children learn in that:

- Knowledge is basically operative. It is about change and transformation

- Knowledge consists of cognitive structures – schemas and concepts

- Development proceeds by the assimilation of these cognitive structures, accommodation and equilibration, each successively building upon itself

- Accommodation refers to adaptation to new experiences and equilibration to the unification of pieces into a whole, which requires a balance of assimilation and accommodation

(Adapted from Piaget, 1953)

Although, on reflection, as a newly qualified teacher I seriously underestimated very young children's capabilities I was fortunate to benefit from in-service training. This included workshops on working in partnership with parents that introduced the Frobel Early Education Project and the work of Athey (1990) on young children's schemas. As a home/school liaison teacher I became responsible for implementing aspects of Athey's (1990) work in community parent and toddler groups.

My interest in young children's schemas was rekindled after reading the work of Nutbrown (1994) about utilising young children's schemas to support their learning. Some of her later books (Nutbrown and Page, 2008; Nutbrown, 2006; 1998; 1996), for me, bridged the gap between theory and practice and gave me the language to share with others my views about supporting young children's learning and well-being. The following quotation now follows me to new places of employment and as I write sits above my desk:

> Children must have time, freedom, space, lack of pressure as well as real challenge, using the 'stuff' of which the world is made – clay, sand, water – and they must have interaction, observation and conversation, from and with respectful educators.
>
> (Nutbrown, 1996, p. 102)

Nutbrown remains a major influence on my thinking about how best to nurture young children's learning and her ideas are frequently cited in this thesis. My research is located within this personal context. It has

influenced the rationale behind my study, alongside other factors outlined in the next section of the chapter.

Research Rationale

Research presents problem solving as a highly desirable learning attribute (Taggart, Ridely, Rudd and Benefield, 2005) and argues that there is a need for it to be developed throughout the early years curriculum and beyond (Taggart 2010). However, in my previous role as a national early years inspector I frequently observed that problem solving in many nurseries was a neglected area of learning and that far less attention was given to it than to physical and language development. This was particularly striking in the assessment records of children under the age of three years, which appeared to focus on their mobility and spoken language. Problem solving appeared not only to be overlooked in these records but also, to judge by conversations with childcare practitioners, to be an area of learning that was little understood.

I concluded that there was no clear and commonly accepted definition of problem solving and that, as Robson and Hargreaves (2005) found in their study of the views of early years practitioners about children's thinking skills, practitioners sometimes found it difficult to differentiate problem solving from thinking skills. Rogers (2004) acknowledges that definitions of problem solving are nebulous and contested. Taggert *et al* (2005) attribute this to what they see as the open and often inconclusive nature of problem solving. Rogers (2004) argues that without a clear and agreed definition, establishing how best to support young children's problem solving 'is a stubbornly hard nut to crack' (p. 24). However, I felt that this should not deter explanation as to why it is so difficult 'to crack' and that a logical starting point in the quest for clarity would be to explore existing definitions of problem solving.

Exploring definitions of problem solving

At first sight, the definition of problem solving may seem obvious, and not susceptible to differing interpretations. The EYFS (2008a), in which it

is one of the six areas of learning, does not define the term, beyond linking it with Reasoning and Numeracy (PSRN) and emphasising the importance of children having the opportunity to play with ideas in different situations with a variety of resources to 'discover connections' (Principles into Practice (PiP) card 4:3, Creativity and Critical Thinking, DCSF, 2008a).

However, the range of anecdotal definitions offered by colleagues and research participants below shows why a definition is needed:

Box 1.1: Definitions of problem solving by colleagues and other respondents

'Problem solving is one of the six areas of learning within the EYFS; it is linked to reasoning and numeracy.'
National Early Years Inspector by e-mail June, 2010

'Problem solving is many things to many people. I like Sue Gifford's (2010) explanation. It's all about problems coming in different sizes and guises, as some problems can be quite minor and arise naturally from activities or can be part of major projects - now she is really only referring to mathematical problems so I am not sure how to define mathematical problems, I will leave that to you.'
Associate Lecturer, by e-mail September, 2010

'Thinking skills are related to encouraging children to learn to think for themselves, learning through real situations in a highly motivating environment.

'Thinking skills which constitute the generic term 'critical thinking' are enquiry, information processing, reasoning, evaluation, problem solving and creative thinking – a good reference for you is Thinking Actively in a Social Context by Wallace, Beverley, Carter, McClure and Rickarby.'
Key Stage One Teacher and TASC (Thinking Actively in a Social Context) framework trainer, by e-mail January, 2011

'Problem solving is the methods you use to find an answer to a problem – application, reasoning and deduction and skills.'
Research participant, owner/manager of a Montessori Pre-school, by e-mail September, 2009

'Problem solving involves skills like calculation that help children think through a problem.'
Research participant, Early Years Practitioner, extract from research journal, July, 2010

'Honestly, I don't know – it's something that happens and sometimes it is not noticed – but sometimes you can plan for it to happen like giving children a new toy that they have to work out how to use by themselves or with adult help, problem solving is part of everyday life really, it is more than you think and all my children do it, even the babies – it is just really hard to put into words but when you see it you know.'
Research participant, Early Years Practitioner, extract from research journal, July, 2010

'Problem solving is working with or through an activity that a kid feels is a problem so it is individual to a kid. For example, tying shoelaces may be a problems for some kids but not for others, for the little ones learning how to climb stairs – it's about expectations, so an early walker would be expected to climb stairs before a late walker and an older kid would be expected to tie his shoes but not younger kids, as adults will help them, so it is not a problem for them, only when adults are not around to help.'
Research participant, Early Years Practitioner, extract from research journal, July, 2010

'MMM, an interesting one! I like this sort of thinking on Monday morning!

'Given their different ages, (Martha is nearly 6 and Flora is 7 months) in my opinion, in different ways – and, at those ages, they have different problems to solve. You can see Flora is trying to make sense of her world by the way she looks closely at things, the way she stuffs things into her mouth and the way she will repeatedly go back to something that she hasn't 'worked out' yet.

'There's also a frustrated cry from her if you interrupt her problem solving or she can't work it out! Martha on the other hand is VERY verbal – so, from the age of about 2 and a half, until a few months ago, she would verbalise what she was thinking out loud and you could hear the various processes she went through.

> 'Now she is starting to internalise much of her thinking but she continues to ask the MOST amazing questions – last week's questions included 'why do people have hairs under their arms' and 'why do dogs bark?'
> *Research respondent, Mother to Martha and Flora by e-mail December, 2010*

Collectively, and perhaps unconsciously, research participants' and respondents' thoughts on problem solving reflect aspects of the literature on this subject. This suggests that problem solving can be seen as a part of critical thinking, involving strategies and skills which enable the problem solver to recognise that things can be changed (Taggart *et al*, 2005). It is important to recognise the fact that problem solving is widely considered to be under the umbrella of thinking skills which also includes:

- Information-processing skills
- Reasoning skills
- Enquiry skills
- Creative thinking skills
- Evaluation skills

(Adapted from Taggart *et al*, 2005)

These skills include attributes and processes, which are also seen to be present in problem solving, namely:

- Collecting and sorting
- Analysing and drawing conclusions from new ideas
- 'Brainstorming' new ideas
- Determining cause and effect
- Evaluating options
- Planning and setting goals
- Monitoring progress
- Decision making
- Reflecting on one's own progress

(Adapted from McGuiness, 1999)

As a component of the generic term 'thinking skills', problem solving is seen by some cognitive psychologists as a 'higher order skill' (Goswami, 2010; Siegler and Alibali 2005) involving metacognition which Brown (1987) divides into two types of knowledge:

- Explicit, conscious, factual knowledge
- Implicit, unconscious, procedural knowledge

(Adapted from Brown, 1987)

Explicit knowledge includes conscious memories that store information about tasks, strategies and people (Siegler and Alibali, 2005) that builds 'content knowledge' (Siegler, 1998 p. 29) and contributes to memory development. In contrast, as Brown (1987) points out, implicit metacognitive knowledge is not conscious and involves three processes: monitoring, comprehension and 'feelings of knowing' (p. 266). Explicit and implicit knowledge working together in the context of problem solving results in:

- Children remembering more than they otherwise would
- An improved ability to learn problem solving strategies
- An improved ability to make plausible inferences
- An ability to remember sequences of events

(Adapted from Siegler and Alibali, 2005)

However, Whitebread (2010), an educational psychologist, argues that metacognition does not operate in isolation and under self-regulation. The extent to which a child performs a task alone and the extent to which that child is supported by an adult or peer, influences problem solving development. The acknowledgment of self-regulation reflects, as Whitebread (2010) shows, a broadening of the role of metacognition in problem solving to include emotional, social and motivational aspects of learning, an area discussed later in this chapter with reference to Bloom's (1956) work on the taxonomy of learning domains. Nevertheless, within the field of cognitive psychology, problem solving appears to be regarded as a cognitive process, which Taggart *et al* (2005), drawing on the studies of Lowrie (2002), conceptualise as:

> One which is creative, self generated and embedded in an organic process of enquiry and learning. (p. 14)

This reflects a Darwinian perspective (2004/1879) in which problem solving is seen as evolving from the human need to control one's environment by understanding the problem and, thereby, how best to overcome it. Problem solving therefore helps the problem solver to make sense of, as well as to manage, their physical world and the challenges that it presents. However, scientific definitions of problem solving describe it more simply, as entailing the circumvention of obstacles to achieve an objective (Muir, Beswick and Williamson, 2008; Klahr and Nigram, 2005).

Mathematical definitions place problem solving at the 'heart of mathematics' (Cockcroft, 1982, p. 1), as a vehicle for developing logical thinking involving a transfer of mathematical skills to unfamiliar situations (National Council for the Teaching of Mathematics (NCTM), 2009). With reference to mathematics, Lowrie (2002) draws attention to the relationship between problem posing and problem solving. The former he defines as 'the creation of a new problem from a situation or experience' (Lowrie, 2002, p. 87), the latter being a solution of a given problem. However, Lowrie (2003) later makes the point that the problem poser does not need to be able to solve the problem for positive educational outcomes to occur. This reflects Lambert's (2000) stance of the 'open and often inconclusive nature of genuine problem solving that may not always have a solution' (p. 32).

It appears that, as Taggart *et al* (2005) state (and the views of other respondents suggest), problem solving poses different challenges and means different things to different people. It can be applied to social interactions involving negotiation, seeking help, expressing ideas, and learning to live as part of a community. As Rogoff (1990) writes:

> A problem solving approach places primacy on people's attempts to negotiate the stream of life, to work around or to transform problems that emerge on the route to attaining the diverse goals of life. (p. 9)

Taggart *et al* (2005, p. 12) distinguish two types of problems:

- Convergent
- Divergent

Convergent problems have a single correct solution or answer. In contrast, divergent problems yield themselves to multiple solutions. Although both are present in everyday encounters, Lambert (2000) clearly shows in his frequently cited study of one child over a period of ten weeks that problem solving could be classified into school-based problems and real life problems forming an interesting contrast. Lambert's study (2000) merits closer examination.

Table 1.1: Characteristics of problem solving

'School based' problems	'Real Life' problems
• Determined by curriculum • Specific information to solve the problem is given • Unknown chosen by adults • Often only one solution • Emphasis on speedy resolution	• Unknown / spontaneous • Either a lot or sketchy information is available • Many solutions may be possible • Often triggers further enquiry (Adapted from Lambert, 2000)

What Lambert's research (2000) illustrates is that convergent problems (and single outcome solutions) are more likely to arise from curriculum based activities while divergent problems are more likely to arise from periods of play and engagement with those problems which arise spontaneously as a result of children's everyday activities. However, the question remains: what distinguishes problem solving from other types of activity?

As Lambert (2000) points out, problem solving is a well-established term that features in everyday common usage and is not a new curriculum or

pedagogical theme. For Siegler (2005; 1998; 1996) whose research solely focuses on children's mathematical and scientific thinking, problem solving involves, and can be characterised by four main cognitive processes, namely:

- Task analysis
- Encoding
- Planning
- Analogical and deductive reasoning

These four cognitive processes are outlined in the later literature review (chapter three) alongside the equally important emotional states that can enhance or impede learning. Bloom, Krathwohl and Masia (1964), drawing on early work of Bloom's (1956) taxonomy of learning domains, term these emotional states as 'the affective domain' (Bloom *et al*, 1964, p. 3) which includes emotions such as:

- Feelings
- Values
- Appreciation
- Enthusiasm
- Motivation
- Attitudes

Carr and Claxton (2002) merge the emotional attitudes with cognitive skills into five learning dispositions, which are characterised as:

- Taking an interest
- Being involved
- Expressing a point of view or feeling
- Taking responsibility
- Persisting despite difficulty or uncertainty

(Adapted from Claxton and Carr, 2004)

In earlier research Carr (2001) describes the five learning dispositions in terms of children being 'ready, able and willing to learn' (p. 10).

Carr (Carr and Claxton, 2002) goes on to link them to the ability to be skilful and confident 'when facing complex predicaments of all kinds' (Claxton and Carr, 2004, p. 91). However, the development of learning dispositions, Carr (2001) argues, does not solely rely on cognitive skills but (in agreement with Katz, 1995) on traits such as habits, attitudes, predispositions and learning styles.

As Brooker (2011) documents, there is an increasing consensus that all children are born equipped with the positive dispositions that support early learning and that children are 'hardwired' to learn through experience (Blakemore and Frith, 2005; Gopnik *et al*, 1999). This is well illustrated by Katz (2001) in her discussion about very young children as scientists:

> Children, all children, are born with the dispositions to make sense of their experiences. This is also what scientists do - make sense of their experiences by experimenting, by utilising the scientific process. You can see this disposition even in babies. A four month old will drop a spoon and watch as Grandma picks it up, over and over again. She (the baby) is a scientist, testing her environment to see what happens. (p. 12)

Katz (2001) is suggesting that the disposition to make sense of experiences is innate, a stance endorsed both by Blakemore and Frith (2005) and Gopnik *et al* (1999). In this light, it could be argued that problem solving is also an innate skill. Baumeister and Vohs (2007) are quite clear that being a successful problem solver does not rely on cognitive skills alone but also on emotional dispositions. As Baumeister and Vohs (2007) conclude, emotional states and motivation alter behaviours and approaches to problem solving in children, just as in adults. In this context, Willoughby (1990) describes problem solving as:

> A situation in which a person wants to reach a particular goal, is somehow blocked from reaching that goal, but has the necessary motivation, knowledge and other resources to make a serious effort (not necessarily successful) at reaching that goal. (p. 50)

Goss (2005) in her study of promoting children's negotiation skills and collaborative learning in an American elementary classroom notes that

problems arise, and are solved, both from social interactions and physical challenges and argues that they are interlinked. However, the majority of the observations made during my main study did not encompass all problems faced by very young children in general. The majority recorded the problems that a group of ten children encountered as part of their play with objects, some of which inevitably were unnoticed by adults. However, aspects of the children's problem solving were captured in my observations. These observations provided an insight into how a group of ten very young children in their problem solving were controlling, managing and making sense of aspects of the world that they encountered in one environment, their nursery through the medium of play. As David *et al* 2003 write:

> Observing children when they play in familiar surroundings is not only enjoyable, because it is during play that children are relaxed enough to perform in ways which demonstrate the amazing extent of what they know and can see. (p. 104)

The rationale for using nurseries as a research location

As previously noted in this chapter, I was aware of gaps in the evidence of problem solving in children's assessment records, and of practitioners' reluctance to discuss their understanding of problem solving. This, and the apparent lack of research into problem solving in early childhood settings, also noted by Goss (2005), became a key part of my rationale in locating my research in children's nurseries.

Additionally, in using a nursery location, I was able to extend my research into how problem solving was supported. During the period when I worked as a national early years inspector I was often impressed by the detailed observations made by childcare practitioners on children in their care and by the wealth of knowledge that many possessed about 'their children'. However, this knowledge seemed to be under-utilised and not used to inform practice to move beyond 'just seeing, just understanding' (Nutbrown, 1996, p. 45). This thinking in part gave rise to my second research question, analysing how the children's allocated key person supported problem solving within the context of the current EYFS (DCSF,

2008a). With this rationale supporting my research questions it became clear that there was value in using nurseries as a research location.

Advantages of using nurseries as a research location

Within the context of my study, there are three main advantages of using nurseries as a location for research into problem solving by children under three. First, it provides a different perspective from studies that observe children in adult-directed problem solving tasks. Second, observing children during their everyday routines enables problem solving to be seen both in terms of cognitive development and of 'emotional valence' (D'Zurilla and Nezu, 1982, p. 12). The impact of emotions on young children's development is increasingly recognised as being of paramount importance in the early years (Evangelou *et al*, 2009). Third, basing my research in nurseries would enable me to share my observations with the children's main carer, their key person (DCSF, 2008a), to utilise their knowledge of the children.

In using nurseries as a research location, I was also able to capture aspects of children's play that preceded, entwined with and followed episodes of problem solving, and to make links between patterns of children's play and problem solving strategies. Unpicking the complexity of young children's play not only aids understanding of children 'at work' but also allows an insight into how children manage their worlds through their feelings, preoccupations, experiences and emerging patterns of thinking. This knowledge, as Broadhead (2006) argues, is crucial for practitioners to extend personal understanding of the learning process in order to create what Nutbrown (1994) describes as a 'thinking curriculum' (p.197) for young children. This approach, Nutbrown (1996) argues, takes account of the fact that young children learn in an integrated way and 'not in neat and tidy compartments' (Nutbrown, 1996, p. 43) and, as Rogoff (1990) points out, does not take place in a vacuum but within a 'social environment' (p. 5). With reference to problem solving, Rogoff (1990) writes:

> The structure of problems that humans attempt to solve, the knowledge base that provides resources and the strategies that are

> considered more or less effective or sophisticated are situated in the social matrix of purposes and values. (p.6)

One crucial aspect of the social matrix that surrounds children, as Evangelou *et al* (2009) emphasise, is the emotional environment that surrounds them. This, Lowrie (2002) argues, appears to be insufficiently acknowledged in previous research into children's problem solving abilities. In locating my research in the children's nurseries, my study is well placed not only to recognise the abilities of children as problem solvers, but also to explore the support by the children's key person (DCSF, 2008a) of their problem solving and the impact of the emotional environment within which the problem solving takes place.

The value of observing the emotional environment within which problem solving takes place

Drawing on Bloom's (1956) taxonomy of learning, D'Zurilla and Nezu (1982) maintain that successful problem solving consists of two related processes: problem orientation, which they describe as 'the motivational/attitudinal/affective factors' and 'cognitive-behavioural steps' (p. 12) - a stance endorsed by Lowrie (2002). Although it is unclear whether, for adults, a positive emotional environment which values, listens and is responsive, actually improves their problem solving capabilities (Spering, Wagner and Funke, 2005), the central significance of emotional warmth and affection in the development of very young children is a recurring theme in early years research (Evangelou *et al*, 2009). Observing very young children 'at work' problem solving in their nurseries therefore allowed more scope to appreciate the importance of the emotional environment, including the 'warmth and contingency of child/adult relationships' (Evangelou *et al*, 2009, p.17).

The importance of warmth and security to a child's development and learning repeatedly recurs as an underpinning theme in my study. In the three participating nurseries involved in my study, the children's principal carers were their allocated key person. This 'special' person in the children's lives not only supported and created opportunities for the

children's problem solving, but also provided the emotional stability in which it took place. Discussion of my observations with the childcare practitioners, although limited in extent, demonstrated the detailed knowledge that they had about the children in their care and deepened my understanding of how young children's problem solving was supported. As already noted and outlined in the next section, I consider that having access to the children's key person (DCSF, 2008a) is an important additional advantage of locating my research in the children's nurseries.

Drawing on the expertise of the key person about children's development and learning

It is important at this stage to be clear about the role of the key person. As previously noted, the EYFS (DCSF, 2008a) defines their role as:

> The named member of staff assigned to an individual child to support their development and act as a key point of contact with the child's parents. (p. 52)

Elfer *et al* (2003) extend this definition to take account of the emotional attachments the children form with their key person encompassing a 'special' relationship that:

> While never taking over from the parents, connects with what parents would ordinarily do: being special for the children, helping them to manage throughout the day, thinking about them, getting to know, help a child to make a strong link between home and nursery. (p. vi)

It is this definition that most closely matched the relationships that existed between the children and their key person who participated in my study. Consequently, it is now adopted throughout the thesis, when reference is made to 'key person'. Further discussion of the key person system and their role in supporting children's well-being and learning is contained in the next chapter. However, it is important to acknowledge at an early stage of the thesis that the attachment between the children and their key person that I observed throughout the main study period clearly went beyond that of the description provided by the EYFS (DCSF, 2008a) and conversations with the children's key person were a valuable resource.

The input of the children's key person was most evident, as chapter five highlights, when unravelling how children made use of particular repeating patterns of behaviour and cognitive strategies which Athey (2007) refers to as 'schema' (p. 5), in their repertoire of problem solving strategies. Although the extent of collaboration with the children's key person was limited to informal discussions and the sharing of my observations, their input, which was based on their knowledge of the children's learning styles and patterns of play, was invaluable in addressing my first research question:

- In their nursery settings what are the main ways children under three use to solve problems during their play?

Key person input was equally invaluable in addressing my second research question:

- In a nursery setting how do the children's main carers - their key person - support their problem solving during periods of play?

Having the opportunity to share my observations and talk to the children's key person (and indeed to the managers of the three participating nurseries) has certainly enriched my study. As well as being rewarding in enabling me to listen to the comments of the seven practitioners and three managers who took part in the study, this dialogue was challenging.

My assumptions, values and beliefs were often questioned (and on occasions opposed). To some extent this questioning arose because I was an outside observer (and, perhaps, in spite of my efforts to reassure, felt to be 'judging' performance) rather than a member of the team (although as discussed in chapter four, I found it difficult to maintain complete detachment). As an independent observer I had the luxury of being able to observe details of the children's play, which were often missing from observations made by their key person. This resulted in 'making the familiar strange' (Delamont, 2002, p. 6), which Delamont (2002) sees as the outcome of analysis and Barbour (2008) uses to describe the aim of reflective practice. However, in the context of my study, this making 'the

familiar strange' prompted my questioning of my objectivity as a researcher.

In the light of this questioning of my objectivity, I feel that it is important, as I have done at the beginning of this chapter, to state the major influences on my thinking about very young children's abilities and how best to support their learning. In doing so, I am aware of a risk of bias in the following two chapters - chapter two: A consideration of theoretical frameworks, and chapter three: The literature review.

Chapter Two

A consideration of theoretical frameworks

Introduction

Nutbrown (2006) argues that for childcare practitioners, observing young children at play is an essential process in supporting their learning. However, as 'just seeing, just understanding is not enough' (Nutbrown 1996, p. 45) I would argue that a more pro-active approach is essential. This entails taking children along their own learning pathways, fully utilising individual children's development patterns, learning styles and preferences (Nutbrown, 2008; 2006; 1998; 1996; Nutbrown and Page, 2008). This embraces the concept of the child as an active learner with a capacity for 'uninterrupted, unthwartable and multidisciplinary learning' (Nutbrown, 1996, p. 44).

The very young child, it is clear, is a competent learner and it is this perspective of development so well evidenced by Goswami (2010) and Gopnik *et al* (1999) that underpins my study. From this perspective it becomes clear that in the light of neuroscience research carried out in the 1990s, 'the decade of the brain' (Bush, 1990), other approaches to child development have seriously underestimated young children's capabilities. Very young children are currently accredited, at least in research circles, with a greater range of perceptual skills and conceptual understanding, which tends to confirm their status as active thinkers and learners (Evangelou *et al*, 2009; Blakemore and Frith, 2005; David *et al*, 2003; Chen, Siegler and Daelher, 2000; Gopnik *et al*, 1999; Brierley, 1994).

What is currently known about how babies and young children learn?

As Barnet and Barnet (1998) state, the nature versus nurture debate is now increasingly being seen as a lifelong dialogue between inherited tendencies and life history. It is widely acknowledged that the brain is capable of lifelong learning (Blakemore and Frith, 2005; Bruer. 1997). However, as Blakemore and Frith (2005) amongst others (Gopnik *et al*, 1999; Languis, Snade and Tipps, 1980; Shore, 1997: Brierley. 1976)

emphasise, in the early years children's brains are much more active than adult brains. To those of us who have watched babies trying so very hard to make sense of the world, this is no surprise.

Goswami (2008) illustrates well the competent-infant developmental theory in presenting research that shows that babies are able to perceive the world and to classify their experiences along many of the same dimensions as those used by older children and adults. Impressive capabilities that research has uncovered include the ability of babies under six months to imitate the actions of others (Meltzoff and Decety, 2003), to make assumptions about causal connections between events (Chen *et al*, 2000), to show preference and boredom (Fantz, 1961), to perceive which objects are closer and further away (Atkinson, 1984), to have an understanding about the properties of objects (Baillargeon and Graber 1998), and to be able to adjust their actions to pick up objects of different sizes and shapes (Bruner, 1973).

Findings like these strengthen the view that children are cognitively competent from birth. However, as Atkinson (2000) argues with reference to the visual capabilities of babies, one of the major problems of interpreting evidence of the abilities of newborns is the fact that even a twenty-four-hour-old baby has had at least a day in the world, and nine months in the womb before that. This makes it difficult to determine whether competency is innate, how much is 'genetically time-released' (Slater and Morrison, 1985, p. 337) and how much is acquired with experience. Nevertheless, neuroscience research findings constantly confirm the status of young children as competent learners (Goswami, 2010). This is the focus of the next section.

<u>Acknowledging the influence of neuroscience research findings</u>

Goswami (2008) in her synopsis of neuroscience research findings provides convincing evidence about children's abilities to make sense of the world. Her synopsis indicates a now widespread belief that almost all

the neurons - the active nerve cells forming the 'grey matter' of the brain, which will eventually comprise the mature human brain - are formed in the womb and are present from birth.

While the total number of neurons in the brain remains relatively constant, the number of synaptic connections (electrical messages) between neurons undergoes significant change in the early years. This change is seen in the overproduction and subsequent pruning of the synaptic connections. These circuits allow the infant brain, as Gopnik *et al* (1999) describe, to work both as a computer, to process information, and as computer software, to decode information. These functions are supplemented by the ability of the brain to change, known as 'plasticity' (Brierley, 1976, p. 23). This ability to change is not a simple acquisition of information but a constant shifting and re-organisation of thinking.

> Brain volume quadruples between birth and adulthood, because of the proliferation of connections, not because of the production of new neurons. (Goswami, 2004, p. 3)

As Blakemore and Frith (2005) point out, with the advent and increasing sophistication of imaging technology, research has provided specific insights into the working of the brain, showing which parts of the brain are activated during mental activity. It has long been known, for example, that different people use different approaches to solve problems (Pólya, 1956). In addition, longitudinal research involving assessment of the same repeated task has revealed that the same person often thinks about the same type of problem in multiple ways (Siegler and Chen, 2002). This has been confirmed when problem solving performance has been monitored by imaging technology, enabling the study of the human brain at work *in vivo*, and showing that each individual responds differently to tasks using different areas of the brain (Bell, 2001; Fisher and Rose, 1996). As Shaywitz *et al* (2002) demonstrate, each individual appears to have a different 'response rhythm' (p. 102). In addition, Shaywitz *et al* (2002) suggest that some individuals are more responsive to certain problem

solving tasks than others and that they are more receptive to different types of support and guidance.

As discussed in chapter five, Analysis and Findings, the concept of response rhythm (Shaywitz *et al*, 2002) became of interest as a result of the many main study observations that captured the children following (and absorbed in) schemas (Athey, 2007) during periods of problem solving. In some of the observed scenarios the problem solving guidance from adults that disrupted the children's patterns of thought resulted in the children either assuming the role of a non-participant observer or losing interest in the task. This suggested that tuning into the rhythm of the children's interest and current patterns of thinking was a productive method of supporting and extending their problem solving. This reflects the conclusions of Athey (2007) and Nutbrown (1994) on supporting young children's schemas to promote consistency, continuity and progression in their learning.

Siegler (2005) shows that children use both active and passive learning mechanisms as they try to construct their own problem solving strategies. This is illustrated in research into young children's abilities to solve novel problems (Siegler and Jenkins, 1989), and to model their learning on adult-directed teaching, further discussed in chapter three. However, what prompts children's choice and generates changes of strategy is still unclear, as Siegler (1996) maintains:

> There is no shortage of constructs hypothesized to produce change: maturation, readiness, differentiation and integration, assimilation, accommodation and equilibration, zone of proximal development, conceptual restructuring, social scaffolding and so on... However, they serve more as placeholders indicating that there is something important to be explained than as a well-specified mechanism.
>
> (p. 16)

Reintegrating this, Goswami (2010) acknowledges that understanding of different rates of learning and of how connections are made is still an area under investigation and that this is a 'major goal of neuroscience' (p. 1).

However, Schore (2001) in her research findings confirms that learning is not imprinted on to a pre-set template and that individual innate capabilities work in active communication with individual experiences. In addition, brain nerve cell connections appear to be stimulated through experience (Goswami, 2010; Carter, 1999; Lashley, 1950). These connections, described by Brierley (1976) as 'engrams - a kind of wiring left behind in the brain as conscious experiences' (p. 92) - allow the transfer of a response from one stimulus to another. Such neuroscience research is broadening understanding about brain development and learning. This is illustrated in Shore's (1997) summary of the differences between 'old thinking' and 'new thinking' that draws on a number of neuroscience research findings.

Table 2.1: Differences between 'old' and 'new' thinking about brain development (Shore, 1997)

Old Thinking	**New Thinking**
How a brain develops depends on the genes you are born with.	How a brain develops hinges on a complex interplay between the genes you are born with and the experiences you have.
A secure relationship with a primary caregiver creates a favourable context for early development and learning.	Early interactions don't just create a context: they directly affect the way the brain is 'wired'.
Brain development is linear: the brain's capacity to learn and change grows steadily as an infant progresses towards adulthood.	Brain development is non-linear: at certain times there are sensitive periods at which conditions for particular types of learning are optimal. These are often referred to as 'critical periods'.
Young children's brains are much less active than the brains of adolescents and adults.	In the early years children's brains are much more active than adult brains: high levels of activity have reduced considerably by adolescence. (Adapted from Shore, 1997, pp. 16 - 17)

There remain questions about how influential this new thinking is in informing educational practice (Blakemore and Frith, 2005) and policy, particularly in early years (Hannon, 2003). Certainly, neuroscience research findings have influenced later educational thinking (DfE, 2011; Evangelou *et al*, 2005, Gehardt, 2004, David *et al*, 2003). For example, Schore (2001) links secure emotional relationships between caregivers and babies with growth of the hippocampus area of the brain (a structure in the brain which is particularly important in forming new memories and connecting emotions and senses, such as smell and sound, to memories). This reaffirms the importance of the key person system in out-of-home care settings.

However, there are claims that neuroscience research findings are sometimes misunderstood (Bruer, 1997) or over-generalised (Ansari, 2005), leading to a proliferation of misconceptions. These have been aptly termed 'neuromyths' (Organisation for Economic Co-operation and Development (OECD), 2002). Hall (2005) argues that neuromyths are manipulated, so that what is accepted as a truth is very much in the eye of the beholder, reflecting the cultural and the class values of the latter. This could be applied to what Davis (2000) refers to as 'brain-based learning packages' (p. 1). An example may perhaps be found in the use of baby videos to stimulate infants' cognitive thinking in their first six months, widely reported in some arenas to be a crucial period of brain growth (Baby Einstein, 2010), whereas research findings point to on-going sensitive periods throughout early childhood, as opposed to a six-month window (Blakemore and Frith, 2005).

Goswami (2004) suggests Bruer (1997) is too pessimistic and gives examples of how neuroscience research is broadening our understanding of brain development and learning. In the area of problem solving this includes neuroscience findings that indicate the ability of the young brain to orchestrate a large number of processes (Baillargeon, Li, Ng and Wang, 2009), which supports the findings of earlier psychological cognitive research indicating that children under three use a number of different

strategies to solve problems simultaneously (Chen, Sanchez and Campbell, 1977). These research findings affirm young children's problem solving abilities. They show that young children are able to use strategies that are considerably more sophisticated than any methods based on random trial and error. Even trial and error Siegler (1996) sees as being less random than it may appear to be; instead, it is a feature of active and passive learning within the brain, when children (as well as adults) solve a problem without realising how they have done so. Research in the problem solving arena is being supported by the findings of neuroscience and continues to reaffirm and build on what is known about the competencies of very young children. In particular, as Keen (2011) maintains, scientific evidence is supporting the more established Piagetian theory of child development, that of the child as an active learner who is able to make sense of the world. This is the focus of the next section.

The child as an active learner and the constructivist approach to how young children solve problems

It is important to emphasise that the process of children's cognitive development and the pattern it takes, as James and Prout (1977) highlight, are socially constructed. They argue that in contemporary western (Anglo-American) orthodoxies, dominant child development theories place an emphasis on viewing children's development as following a universal pattern. This pattern progresses through a series of stages. Although not dismissing the importance of the child's family and of the wider social domain on children's development, Driscol (2002) argues that within the western orthodoxies less emphasis is placed on this than by the work of Vygotsky (1978). Essentially, as Driscol (2000) shows, the predominant constructivist approach to child development arising from the work of Piaget is based on a concept in which:

> Knowledge is a web of relationships and is constructed actively by learners as they attempt to make sense of their experiences and environments. (Driscol, 2000, p. 20)

As Driscol (2000) states, within the constructivist approach cognitive

development is seen as having an identifiable structure of competencies, consisting of a series of predetermined stages, which lead towards the eventual achievement of logical competence. Development, therefore, is seen as involving a transition from one coherent way of thinking to a different way of thinking, activated through, as Piaget (1953) maintains, interaction with the environment that children construct from their own mental and physical actions.

Within Piagetian theory this change occurs as three cognitive processes: assimilation, accommodation and equilibration, each successively building upon itself. Assimilation refers to the way in which incoming information is transformed so that it fits existing ways of thinking; accommodation refers to adaptation to new experiences; and equilibration to the unification of pieces into a whole, which requires a balance of assimilation and accommodation.

With reference to children under six, Piaget uses the term 'schema' (1953) to refer to cognitive structures. Although, as Athey (2007) acknowledges, Piaget often used the terms 'schema' and 'scheme' interchangeably, Piaget (1971) describes schemas in the following way:

> Cognitive structures contain within them elements of 'perception', 'memories', 'concepts' and 'operations'. These are linked together in various types of connections. These connections may be spatial, temporal, causal or implicatory. Structures can be organic, as in very early behaviour, or static or dynamic. (p. 139)

This definition encapsulates the concept of children as active agents making sense of, controlling and managing their environment by utilising self-generated concepts. In this, as Siegler and Alibali (2005) state:

> Reality is not waiting to be found; children can construct it from their own mental and physical actions. (p. 33)

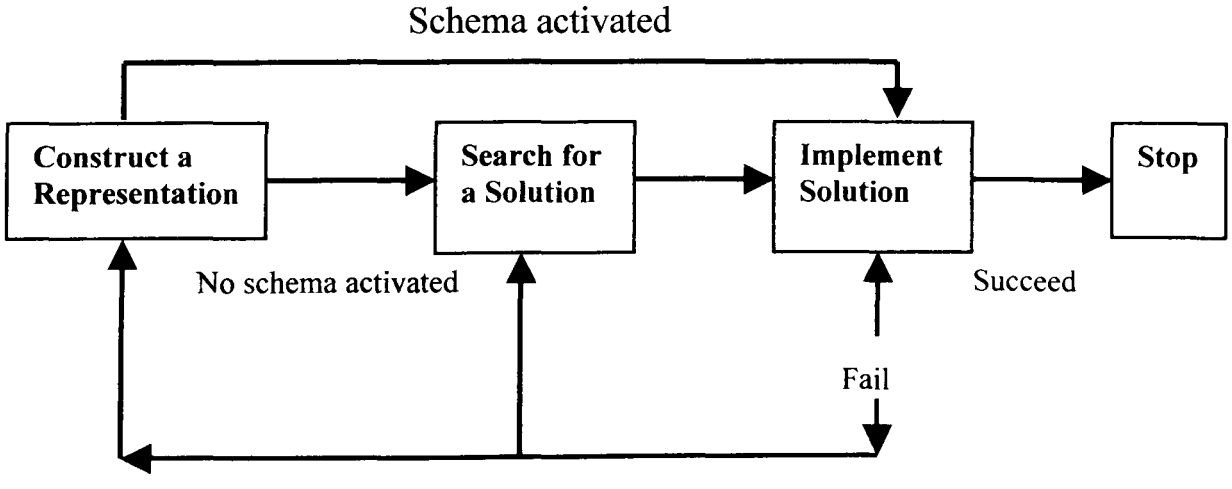
Willatts (1990) acknowledges that problem-solving strategies are essentially schematic in that there are goal directed operations, constructed from mental and physical actions. Additionally, strategy use can be considered to be:

- Deliberate
- Working towards an end goal (although that end goal may not always lead to an adult's interpretation of a completed task)
- Involving patterns of thinking which organise knowledge, information and action

(Adapted from Willatts, 1990)

However, Harnishfeger and Bjorklund (1990) in their overview of research into children's capabilities as problem solvers argue that definitions of 'strategy' vary amongst researchers. Drawing on the research of Bruner, Goodnow and Austin (1956) the use of problem solving strategies can broadly be defined as 'patterns of decisions' (p. 24). Willatts (1990), with regard to children under two, expands on Bruner *et al*'s (1956) definition, stating that strategies can be considered as deliberate actions, which are used to produce an end goal. The ability to carry out deliberate actions Willatts (1990) associates with decision making, which he argues results from an organisation of knowledge, information and action in a systematic way. This endorses Piaget's (1953) theory, which also indicates that problem solving strategies appear in a definite sequence with a new one arising when the child enters another developmental stage. Problem solving is therefore seen as a series of stages that are triggered by mean-ends behaviour (Piaget, 1953), which places problem solving within an information-processing model of development illustrated by Gick (1986) in Figure 2.1 below.

Figure 2.1: Schematic diagram illustrating problem solving strategy use within the information-processing model (Gick,1986)



(Adapted from Gick, 1986)

This simplified schematic diagram illustrates the first stage of problem solving, in which the problem solver searches for a solution and implements it. If the search is successful the task is over. If it fails, the problem solver backtracks and attempts to redefine the problem and connect it to existing knowledge that, Gick (1986) proposes, consists of memory and clusters of knowledge related to a problem type which she defines as 'schema' (p.101), later redefined as 're-cognition' (Gick and Holyoak, 1987, p. 20).

If schema activation or re-cognition occurs, the problem solver can proceed directly to the third stage of problem solving, i.e. immediately implementing the solution strategies and procedures contained in the schema, a trait recorded by Willatts (1997). In the absence of appropriate schema activation, the problem solver proceeds to the second step – search for a solution – and a search strategy is invoked. Search strategies may involve one or more of the cognitive processes - task analysis, encoding, planning, analogical and deductive reasoning - highlighted by Siegler and Alibali (2005) and further discussed in chapter three.

Willatts (1990) writes that the constructivist approach contained within Piaget's theory is 'attractive' (p. 31), as it appears to explain how problem solving strategies come into existence and that it is the 'only theory that attempts to explain the development of problem solving strategies in infancy' (Willatts, 1990, p. 26). However, there are well acknowledged limitations to the constructivist approach to child development that are applicable to the understanding of young children's problem solving, and which are reviewed in the next section.

Limitations to the constructivist approach in understanding young children as problem solvers

Harnishfeger and Bjorklund (1990) challenge the concept of seeing problem solving strategies within the information-processing model presented by researchers such as Gick (1986) and based on the Piagetian (1953) paradigm of means-end behaviour. They argue that the information-processing model is simplistic as, in responding to problems,

individuals do not behave like computer programs – taking in information, storing it and easily locating it to enable a response. Furthermore, Harnishfeger and Bjorklund (1990) argue that strategies are not necessarily separated and their use may not be as linear as Gick's schematic diagram suggests. Gick (Gick and Holyoak, 1987) later acknowledges this, stating 'of course the problem solver jumps back and forth in their use of strategies' (p. 83), a view developed by Siegler (2005) in his view of overlapping strategy use.

Harnishfeger and Bjorklund (1990) also maintain that strategy acquisition and development can be viewed in two contrasting ways, as a continuous or discontinuous process. As Goswami (2010) reflects, development as a continuous process suggests a gradual accumulation of behaviour, skill or knowledge, which proceeds in a smooth, orderly manner with each change building on to a previous ability. In contrast, a discontinuous process involves reaching stages of development that represent a particular organisation of knowledge and behaviour at a particular time. Therefore, the movement to a new stage of development shows that a qualitative reorganisation of previous knowledge and behaviour has taken place (Piaget, 1952).

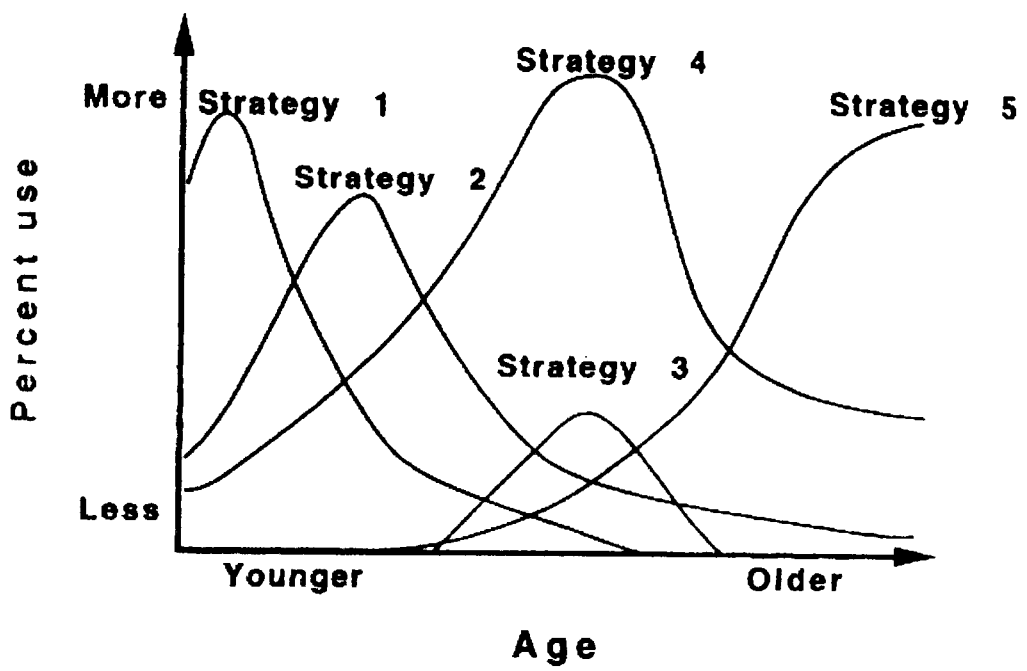
However, Siegler (1996), in his research into the development of children's problem solving strategies, argues that whether a particular aspect of development appears to be continuous or discontinuous depends largely on how development is recorded, a view expanded upon in later research (Flynn and Siegler, 2007). Siegler (1996) gives the example that if change in a given behaviour, such as problem solving, is examined at long intervals or in different age groups, development will look discontinuous (stage-like). In contrast, if children's actions are recorded more closely at shorter intervals, development may appear to be more continuous in nature with no abrupt shifts.

By carrying out high-density observations over a short period of time (microgenetic research), Siegler (1996) created a model to map children's

problem solving development, which he terms 'overlapping waves', in contrast to the more stage-like development pattern which Keen (2011) points out is usually associated with Piagetian theory. In his overlapping wave model the irregular paths of children's development include:

> Regressions as well as progress, short lived transitional approaches, inconsistent patterns of generalization and other complexities.
>
> (Siegler, 2005, p.770)

Figure 2.2: Model of Siegler's (1996) overlapping wave theory illustrating patterns of problem solving development



(Adapted from Siegler, 1996)

Siegler's (1996) model is frequently cited to illustrate the contrast between Piaget's (1983; Piaget and Inhelder, 1971) stance that the development is linear, and the relatively new thinking that development proceeds in a web of multiple strands 'with different children following different pathways' (Evangelou *et al*, 2009, p. 4). This fits in well with the concept of stages of development being overlapping and uneven. This is seen, as Siegler (1996) documents in the context of problem solving, in the way in which children (and adults) generally think about a given problem from different angles, rather than have one single understanding. As a result, children constantly choose what they do. which, Siegler (1996) argues, challenges the stereotypical assumption that depicts children's thinking as 'less variable, less demanding of choice and less

dynamic than it really is' (p. 5). However, Siegler's research is not without its critics.

Fowler (1992) questions the appropriateness of referring to a typical course of development, 'because there is no consensus regarding what typically develops' (p.1239). Fowler (1992) further argues that monitoring change does not capture development, as 'in a developmental sequence change inevitability moves in the direction of an end point' (p.1239). However, Siegler and Crowley (1992) contend that Fowler holds a simplistic view that change follows a one-way direction. This one-dimensional view of change when applied to problem solving does not take account of what Siegler and Crowley (1992) often refer to as the 'U shaped pattern of development' (p.1242). This U shaped pattern of development Siegler and Alibali (2005) contend takes account of the tendency of an individual to make less use of successful strategies and more use of less successful approaches, reflecting choices that may not always seem to be logical and are irregular and deviate from the patterns of others. It is these choices that Siegler and Crowley (1992) claim microgenetic research methods trace. Fowler endorses this in a later paper (Fowler and Feldman, 1997). However, Pressley (1992) continues to question the ways in which observations are conducted in microgenetic research.

Pressley (1992) argues that there are indications that the researchers in the Siegler and Crowley (1992) study into children's ability independently discover new counting strategies appear to provide clues and prompts for children in their follow-up questions, thereby scaffolding children's learning. As a result, throughout the study, children's use of new strategies is adult-directed and not self-initiated. Siegler and Crowley (1992) agree in part with Pressley's (1992) critique but for them the real issue is not whether the research method 'is all virtues and no vices' (Siegler and Crowley, 1992, p. 1243) but that microgenetic research and the use of the overlapping wave model produces more useful data than alternative research methods irrespective of the age of the participant.

With regard to children under three Chen *et al* (2000), drawing on Siegler's (1996) overlapping wave model, demonstrate the mental resourcefulness of two-year-old children. Chen *et al* (2000) evidence that the overlapping thinking strategies used by two-year-old children compete with each other, as with older children. In addition, as some strategies are strengthened and used successfully in response to one problem they are also used to solve new problems. As a result Chen *et al* (2000) conclude that very young children are increasingly able to choose between more subtle variants of a particular strategy to execute it more skilfully. Such research shows that strategy development is far more complex and diverse than Piagetian theory encompasses.

Although Piaget sees the child as an active learner (Piaget, 1953) whose development follows a universal, linear pattern, the sequential stages of development are limited to a child's particular age. This creates a dichotomy: the child is an active learner but one who operates within periods of developmental stages, seemingly unable to progress before completing each current stage. This, as Siegler (1998) maintains, limits adults' appreciation of children's potential, as children are thought unable to learn modes of thought 'much more advanced than those that characterize their current stage' (p. 61). The problem solving skills of very young children therefore are seen as immature and under-developed. This contradicts the findings from later research of Bjorklund, Muir-Broaddus and Schneider (1990) and Siegler (2005) who, as discussed in chapter three, argue that some strategies such as planning, which pre-school children use, are essentially the same as those used by adults.

<u>A summary of the evidence that supports the concept of children under three as competent problem solvers</u>

Drawing on neuroscience research findings carried out mainly in the mid-1980s, Gopnik, Meltzoff and Kuhl (2000) claim that babies and young children under three have the ability to:

- Think
- Observe

- Reason
- Consider evidence
- Draw conclusions
- Experiment
- Solve problems
- Search for the truth

(Adapted from Gopnik *et al*, 2000)

Within the competent-infant perspective, Gopnik *et al* (1999) point out, and in their words 'more significantly' (p. 7), that babies and young children have powerful learning mechanisms which allow them spontaneously to 'revise, reshape and restructure their knowledge' (Gopnik *et al*, 2000, p. 10). With regard to problem solving, Gopnik *et al* (1999) argue that the difference between children as problem solvers and their adult counterparts is that children are not as self-conscious as adults. This was well illustrated during my main study as I attempted delicately to remove a piece of jigsaw posted in the wrong shape sorter. A thoughtful two-year-old who, on seeing my problem, said, 'me do', resolved it by giving the wooden jigsaw piece a wallop with his fist, thereby demonstrating the mechanics of one child's problem solving technique.

Willatts (1997) acknowledges Piaget's major contribution in the assignment of a central role of problem solving in infancy cognition. Whilst not underestimating the contribution of Piagetian theory to how and why problem solving in infancy can be studied, Willatts (1997) concludes that new evidence about the capabilities of children under three as problem solvers demands new explanations. Some new explanations are reviewed in the next chapter, alongside how very young children are supported in their problem solving, and in particular by their main adult carer, their key person (Elfer *et al*, 2003) in their nurseries, with reference to sustained shared thinking (Siraj-Blatchford, Sylva, Muttock, Gilden and Bell, 2002). However, the theoretical frameworks which define the role of the key person (Elfer *et al*, 2003) are discussed here, in chapter two,

alongside the concept of the adult as a 'knowledgeable other' (Vygotsky, 1978).

Theoretical frameworks within which the role of the key person as a 'knowledgeable other' is situated

The development of the key person system

Nash and Hay (2003) trace the development of the key person system back to the 1920s and the attention given during this period to children's emotional development in the writings of Isaacs (1926), amongst others (Klein, 1921-1949/1975). The central tenet of the key person system, Harris (1999) argues, is a derivative of the attachment theory (Bowleby, 1953), which emphasises the importance of the infant/ main adult carer, primarily and importantly to one person (Harris, 1999).

How this infant/main adult carer attachment works in practice can be seen in Bain and Barnet's (1980) study of one nursery. The study proposes the adopting of a care assignment system in which each child is predominantly cared for during the day by 'his nurse':

> Whom he could turn to for love, attention and help, at mealtimes, in play, when he needed comfort and affection, being changed, being helped on the lavatory, and washing. (p. 72)

Goldschmied and Jackson (1994) elaborated on this and outlined practical steps for implementing and managing such personalised childcare systems, which they termed the 'key person approach' (p. 35). Within this approach, Goldschmied and Jackson (1994) emphasise the importance to children of adult (carer) physical proximity and care in out-of-home care settings, which has been, and continues to be challenged. Penn (1997) argues that the key person system does not work in practice and that it is really about 'surveillance and monitoring of individual children' (p. 52). Moss (2006) locates the key person approach in a wider 'maternalist regime' (p. 26) which, he argues:

> Remains dominant in many countries, still productive of attachment pedagogy and the worker understood as substitute mother and sustaining a highly gendered workforce. (p.37)

Elfer *et al* (2003) maintain that childcare practitioners (the children's key person) are 'special adults' in some children's lives but the role that they play is not the same as the children's parents. Elfer *et al* (2003) maintain there are similarities between the children's parents and the children's key person, but 'similar does not mean the same' (p. 6). They argue that although a key person has an attachment to a particular child, this is a professional intimacy, which provides stability, trust, care and learning experiences matched to children's developmental needs. The key person/child relationship was not envisaged as an exclusive relationship. As Elfer *et al* (2003) state:

> The point of the key person principle is not to restrict children's interactions with other members of staff but to be sufficiently responsive when they want intimacy and closeness with their special member of staff. (p. 14)

Challenges to the key person approach

Selleck and Griffin (1996) point out that the key person system is culturally specific. In their example of Italian nurseries, they point out that key relationships with a significant adult are not seen as necessary to children's successful development in group care where:

> Children are encouraged to respond to the environment and to small groups and adults and children rather than a key adult. (p. 156)

Nash and Hay (2003) highlight, in their analysis of social relations in infancy, that a very young child's attachment to one adult is a partnership between two unequal partners – 'relatively helpless infants and more mature, socially sophisticated caregivers' (p. 2). Consequently, adults in supporting children's learning, may misinterpret young children's meanings and actions so that children appear 'more sophisticated than they actually are' (p. 3). Similarly, Dahlberg, Moss and Pence (2007) question the suitability of the key person approach in accommodating the concept of the child as a 'co-constructor of knowledge, identity and culture' (p. 52). More strikingly, Statham and Mooney (2006) argue that the intimacy associated with the key person role in group care settings amounts to a 'false closeness' (Statham and Mooney, 20006, p. 86) which, Dahlberg *et al* (2007) contend feeds into the concept of the 'poor' child –

'weak and passive, incapable and under-developed, dependent and isolated' (p. 52).

A consideration of views about the key person approach

As David *et al* (2003) state, the description of the Italian nursery model (highlighted in the previous citation) points to the absence of a key person support system. However, it still reinforces the idea of a small but significant number of adults and children being together so that meaningful relationships can be formed. Research is providing evidence that very young children are capable of forming multiple relationships and that, if these relationships are stable and good childcare is provided, children thrive (Rutter, 1973: Rutter *et al*, 2007). What the key person system provides, I would suggest, is the means by which a child can experience a close attachment with another adult. There are of course doubts, as Nutbrown and Page (2008) highlight, as to whether all practitioners and managers have yet been able to understand and interpret the subtleties of the key person's role 'and put this complex role into practice' (p. 98). However, some research indicates that the role of the key person can make a difference to young children's positive social and emotional development and ability to learn (David *et al*, 2003).

My study endorses the role of the key person, and welcomes the development of a professional identity which Manning-Morton (2006) describes in terms of 'critically reflective, theoretical boundary crosser' (p. 50). Manning-Morton (2006) sees this professional identity as a development of the existing skills of the early years practitioner, who:

> Can see young children as powerful active learners with autonomy and agency and yet still hold their dependent and vulnerable selves in mind, hear their distress or angry voices and accept the centrality of their physical process to their sense of self and learning. (p. 50)

In this role, the key person can be seen to be an effective 'knowledgeable other' (Vygotsky, 1978) in supporting children's learning, as briefly discussed in the next section of this chapter.

Situating the key person in the context of a 'knowledgeable other'

Vygotsky's (1978) concept of adults and children's more capable peers as 'knowledgeable others' envisages them acting both as instructors and role models, thereby closing the gap between what children can do alone and what they can do with the help of someone more skilled and experienced. However, as Arnold (2003) points out in her close observation of the development of her grandson Harry, Harry does not simply imitate an adult or more capable peer, but engages in a relationship in which all share knowledge and responsibility for the task.

Siegler (2005) maintains that an important part of the child/adult relationship is the support offered by adults through instruction, in the early years context. However, Wood (1988) argues that adult instruction is effective only when the child initiates the activity, and that adult support of children's learning should be seen not in terms of teaching *per se* but as facilitation and scaffolding. Williams, Mastergeorge and Ontai (2001) acknowledge a long line of research which documents the ways in which adults adopt and effectively use scaffolding strategies (Berk and Winsler, 1995, Wood, Bruner and Ross, 1976) or guided participation (Rogoff, 1990) to support young children's learning. These strategies include:

- Offering suggestion
- Giving gentle feedback
- Adapting the environment in order to facilitate learning opportunities

(Adapted from Wood *et al*, 1976)

However, one way of scaffolding young children's thinking (and problem solving) is perhaps best illustrated in the use of the sustained shared thinking framework (Siraj-Blatchford *et al*, 2002). The use of sustained shared thinking (Siraj-Blatchford *et al*, 2002) as an illustration of the role of the children's key person as 'knowledgeable other' (Vygotksy, 1978) is discussed in the next chapter following an overview of the process of how children solve problems.

Chapter Three

Literature Review

Introduction

Gopnik *et al* (1999) describe young children as 'fascinating, mysterious and plain weird' (p. 6). The aim of the literature review is to take the 'weird' out of looking at the development of young children's problem solving by bringing together key aspects of the mechanics of how children solve problems. The literature review also examines how adults support young children's problem solving abilities in a nursery setting, focusing on the role of the children's key person.

As outlined in chapter two, the competent-infant perspective of development (Gopnik *et al*, 1999) influences this literature review. From this perspective it becomes clear that, in the light of neuroscience research carried out in the 1990s, other approaches to child development have seriously underestimated young children's capabilities. Children under three are currently accredited with a wider range, than previously thought, of perceptual skills and conceptual understanding. This research confirms their status as active thinkers and learners (Goswami, 2010; Evangelou *et al*, 2009; David *et al*, 2003; Gopnik *et al*, 1999) and effective problem solvers (Siegler and Alibali, 2005).

This literature review summarises a range of current research findings to place my two research questions into context. It is divided into two main sections, which address each research question in turn. The first question is:

- In their nursery settings what are the main ways children under three use to solve problems during their play?

The first section highlights research findings that illustrate the role of play in children's learning, its link with the development of children's problem solving skills and the cognitive processes that very young child children use when given problem solving tasks.

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The second section of the literature review explores issues surrounding my second research question:

- In a nursery setting how do the children's main carers - their key person – support their problem solving during periods of play?

In this section the role of the children's key person (Elfer *et al*, 2003) as the 'knowledgeable other' (Vygotsky, 1978 p. 89) is discussed. This discussion focuses on shared thinking (Siraj-Blatchford *et al*, 2002). In addition, it reviews the emotional support given to very young children, linked to the concept of 'tuning into' children (Selleck and Elfer, 1997), that the key person system is well situated to offer.

Play and Learning in the Early Years

As Wood (2010a) acknowledges, there is no commonly accepted definition of what play is; nor is there a common understanding of the nature and extent of its contribution to children's learning and development (Manning-Morton and Thorp, 2003). Although not claiming that play is an exclusive mode of learning in early childhood, David (2003) acknowledges that there is research evidence to demonstrate that child directed playful experiences are important and notes that research on play currently has changed from 'What is and why does play occur' to 'What does play do for the children?' and 'How can good quality play contribute to children's educational progress and achievement?' (David, 2003, p. 11).

Play is frequently presented as a highly complex activity with many aspects and characteristics (Evangelou et al, 2003). As Vygotsky (1978) recognised, children's play may show little evidence on the surface of the complex thinking which underpins it. Bruce (2001) describes the importance of play in terms of opportunities for children to combine ideas, feelings and relationships with the application of knowledge and skills. Katz (2008), drawing on the Vygotskian concept of the 'knowledgeable other', also emphasises the role of play in allowing children to

co-construct knowledge with other children and adults who scaffold their experiences.

As David (2004) states, play does not easily lend itself to predicted and prescribed outcomes. In the first place, as Howard (2011) highlights, it is difficult to isolate the benefits of play from the wider repertoire of children's activities, because play activities enable children to make connections with many areas of learning. Second, any benefits of play need to be seen as part of a process. However, Broadhead, Howard and Wood (2010) aptly describe children's play as 'work in progress' (p. 12). Here, the connection is made between play as a medium for the development of attributes and skills. Honig's (2006) observations of children under five at play in Montessori nursery settings for example, highlight the development of attributes and skills ranging from the acquisition of body gracefulness to the development of mathematical skills, such as number and time concepts, spatial understanding and causality reasoning. In contrast, Amsel and Smalley (2000) see play as an opportunity to explore alternatives and possibilities. However, Dockett and Lambert (1996) serve a timely reminder that play for very young children is intrinsically motivated, giving children the freedom to learn though self-initiated and spontaneous movements 'often driven by children's motivation to explore their worlds' (p. 3).

In the context of problem solving, Reikeras, Loge and Knivsberg (2011) suggest that play serves as a platform in which specific problem solving skills, as well as innovative thinking, can be developed and consolidated. Whitebread *et al* (2004), drawing on their research into children as independent learners, observe that play offers children opportunities to make choices and decisions, and to pursue 'their own plans and agendas with persistence and sometimes over surprisingly long periods of time' (p. 13). This, Whitebread *et al* (2004) emphasise, gives children autonomy in, and ownership of, their learning, thereby giving value 'by making the learning process explicit to the child' (p. 2).

The emphasis which Whitebread *et al* (2004) place on the importance of making the learning process explicit to the child supports earlier research findings (Wyer and Spence, 1999) that indicate that play, notably sociodramatic play, provides the incentive for children to develop their problem solving skills. In addition, for very young children, self-initiated play may be a precursor to later problem solving skills (Sylva, Bruner and Genova, 1974). These conclusions have been further reinforced by the findings of Gopnik *et al* (2000) and more recent research (Foreman, 2010), which strongly indicates that play provides opportunities for children under three to 'think like scientists' (p. 1). Foreman (2010) in his observations of two-and-there-year-old children at play videoed scenarios in which children displayed cause and effect thinking that revealed 'a legitimate form of scientific thinking' (p. 5.).

Such research reinforces the value of play experiences and forms an alliance with the growing body of neurological research that justifies the importance of play in the first five years of development (Blakemore and Frith, 2008). This is resulting in a continuing focus on the importance of play in young children's learning, and as Casby (2003) argues, its role in early childhood intervention efforts. However, as Wood (2010a) points out, while many studies have been influential in identifying the benefits of play, making links between play and learning, and play and pedagogy, has 'always been problematic' (p. 12). Wood (2010b) goes on to argue that in the climate of the current Early Years Foundation Stage curriculum guidance (DCSF, 2008a) the pedagogy of play is not yet fully defined. As a result, early years practitioners continue to have problems defining their role in assessing children's learning through play and understanding when and how to be involved. This reinforces the vulnerability of a pedagogy that recognises the importance of young children's learning through play but does not always follow this through in practice, despite the number of studies that place play at the centre of children's learning (David *et al*, 2003).

The role of play both in presenting children with problems to solve and providing the flexibility with which to find a solution, Taggart *et al* (2005) acknowledge, is an important aspect of what is currently known about how very young children solve problems. This complements the focus of research such as Siegler's (2005) on the active and passive learning mechanisms of children's problem solving, which is discussed in the next section.

What is currently known about the learning mechanisms that very young children use to solve problems?

As previously noted, Siegler's (2005) research findings indicate that children use both active and passive learning mechanisms in their play when constructing problem solving strategies. Siegler and Jenkins (1989) illustrate children's abilities to solve novel problems using adult-directed teaching as well as their own intuitive knowledge. Siegler (2005) maintains that adult-directed and intuitive problem solving complement each other and result in two rates of learning, the first of which Siegler (1998) labels the 'rate of discovery' (Siegler, 2005, p. 280) and the second, the 'rate of uptake' (Siegler, 2005, p. 281). Siegler (1998) places these rates of learning into an everyday context, drawing on the example of Archmides:

> Brooding on a problem for a prolonged period and then exclaiming 'Eureka' after entering the bath. Discovery takes a long time but uptake is instantaneous. In other cases discovery is rapid but uptake is slow. (p. 456)

Goswami (2010), as previously noted, recognises that understanding about different rates of learning and how connections are made is still an area under investigation. However, Schore (2001) in her research findings concluded that learning works in active communication with innate capabilities and experiences. As Gopnik *et al* (1999) maintain, newborn babies are already working hard to make sense of and manage their world. Children therefore can be seen to be problem solvers from birth, which is quite an exciting concept to work with.

Goss (2005) places literature on young children and problem solving into four broad categories:

- Studies of children's responses to problem solving exercises entailing the use of materials and tools
- Studies of children's responses to formal training in problem solving techniques
- Studies of social and collaborative problem solving
- Descriptions of problem-solving events written by practitioners

(Adapted from Goss, 2005)

Overviews of these categories are incorporated into reports about problem solving and its place in education (Taggart *et al*, 2005) and serve to inform other literature reviews within the early years field (Evangelou *et al*, 2009). Taggart (2010) in his review of childhood cognitive research concludes that although current findings are highlighting children's abilities as problem solvers, it remains unclear as to whether problem solving is an innate skill or one that is culturally nurtured. In contrast, Siegler (1998), in part inspired by the evolutionary ideas of Darwin, argues that problem solving strategies such as reasoning, curiosity, imitation, imagination, language and self-consciousness, 'emerged in the course of evolution' (Siegler, 2005, p. 5).

I would suggest that it appears reasonable in the light of current research to view the ability to problem solve as a combination of innate skills, evolutionary development and changing cultural influences. It remains unclear, and open to further debate, which areas are dominant. However, drawing on the research of Siegler and Alibali (2005), what is relatively uncontested is that problem solving, even for the very youngest children, involves a series of cognitive processes.

Siegler and Alibali (2005) present the mechanics of problem solving as a series of cognitive processes that are utilised in different ways. These cognitive processes in young children, Bjorkland *et al* (1990) and Siegler (2005) both argue, are essentially the same as those of adults.

Siegler (2005) identifies four cognitive processes that underpin problem solving, namely:

- Task analysis
- Encoding
- Planning
- Analogical and deductive reasoning

(Siegler and Alibali, 2005, p. 10)

In the following sections of this chapter, I briefly describe these four cognitive processes. My intention is to dispel what I consider to be the mystery that surrounds them.

An outline of the four cognitive processes that underpin problem solving

An overview of task analysis

Much of Siegler's research reveals the capability of children to analyse a task and plan, and fine-tune their planning, to meet its demands (Siegler and Alibali, 2005; Siegler and Chen, 2002; Siegler, 1995; Siegler and Jenkins, 1989; Siegler and Richards 1979). In doing so, they apply what Siegler (1998), citing the work of Klahr (1989), labels 'means-ends analyses' (p. 261). Drawing on Piagetian research, Klahr (1989) infers that means-end analyses involve identifying the goal to be achieved and using this information to find ways to achieve it. This indicates an ability, confirmed in Willatt's (1990) research with children under two, to construct simple mental models of the task in order to process information.

An overview of encoding

Siegler (2005) describes encoding as a process that:

> Applies attention and associates context and existing knowledge to sensory data to make it more easily remembered. (p. 36)

Siegler (2005) maintains that encoding involves forward planning working in parallel with causal inference, i.e. inferring the cause of an event or phenomenon from the evidence observed. Furthermore, Siegler and Alibali (2005) view causal inference as fundamental to the formation

of rules in the child's thinking about how the world works. Willatts (1990) observed that during their second year, children can employ an intentional and simple forward search strategy based on their knowledge of the problem, and that they use the information to achieve a goal and to guide subsequent actions. This finding is confirmed by later research with children in the ten-to-thirteen-month age range (Chen *et al*, 1997).

An overview of planning

Siegler (1996) notes that children plan from infancy onwards. He maintains that this begins with a simple thought – to plan or not to plan. Epstein (2003), building on Siegler's (2005) research, makes the point that planning is more than randomly making choices; it is making choices 'with intent' in the chooser and 'begins with a specific goal in mind that results in their choice' (Epstein, 2003, p. 2).

Siegler and Alibali (2005) highlight features of children's planning in the following statements, which, they point out, are as relevant to adults as to children:

- Planning is an active process
- Planning takes time, but children often value speed over accuracy
- Generating plans is no guarantee of successful outcomes
- Planning is often subjectively unpleasant because it is difficult, tedious or anxiety-producing
- Unplanned action can be enjoyable in its own right, since it can place children in increasingly interesting situations

(Adapted from Siegler and Alibali, 2005)

Siegler (1998) identifies analogical and deductive reasoning as the underlying cognitive process supporting planning, which Skemp (1989) sees as a feature of inner logic. Muir *et al* (2008), building on the work of Pólya (1956), see this in terms of children having the ability to plan and work methodically, using a series of tactical behaviours such as:

- Decision making
- Strategy selection
- Deciding on a direction

- Abandoning a direction when appropriate

(Adapted from Muir *et al*, 2008)

These findings reinforced Siegler's (1995) conclusion that children under six are skilled in employing tactical behaviours, for example using alternative strategies when existing ones were successful, a trait also researched by Chen *et al* (2000) with two-year-old children. In an earlier study, Chen *et al* (1997) highlighted that younger children, like their older counterparts, could detect and use information about their failures to solve a problem and to make further attempts. Lambert (2000) describes the ability to restructure - to go back a few steps and try something else - as 'planfulness' (p. 6), which involves analogical and deductive reasoning.

<u>The role of analogical and deductive reasoning behaviours</u>

Siegler (1998) describes reasoning as a 'pervasive and powerful process' (p. 265) that involves identifying structures or functions in objects and then subjecting them to comparison. This involves a transfer of information, which as Gopnik *et al* (1999) state, with reference to babies and very young children, also encompasses their recognition of objects, places and people.

By assigning tasks that are more relevant to young children's experiences, current research into the deductive abilities of children under three is increasingly uncovering sophisticated reasoning abilities (Chen *et al*, 2000; Willatts, 1997). As a result, research findings are indicating the ability of children under three to think systematically and, more importantly, draw deductive conclusions.

Chen *et al*, (2000) in their study of children's use of different lengths of rakes to retrieve a toy, present the very young child's ability to draw deductive conclusions as a pattern of strategic development which arises from five component processes, namely:

- Acquiring the strategy
- Mapping the strategy on to novel problems
- Strengthening the strategy so that is it used consistently within a

framework of given types of problems

- The ability to refine the choices of problem solving among alternative strategies
- The ability to be increasingly effective in the accuracy and speed of execution of problem solving, or series of problem solving strategies

(Adapted from Chen *et al*, 2000)

Goswami (1992) suggests that there is still research to be done to fully understand the role of analogical and deductive reasoning in the cognitive development of children under three. However, Chen *et al* (2000) conclude that three-year-old children are able to demonstrate reasoning, 'following the same thinking procedures as adults' (p. 93). The question, however, remains, what do these cognitive processes 'look like' in the nursery setting?

Problem solving as a compendium of skills and behaviours

Drawing from a range of literature (Goswami, 2010; Evangelou *et al*, 2009; Siegler and Alibali, 2005; Gopnik *et al*, 1999) and research findings into the problem solving abilities of children under three (Baillargeon *et al*, 2009; Chen and Mo, 2004; Coltman, Anghileri and Petyaeva, 2002; Chen *et al*, 2000; Baillargeon, 1997; Chen *et al*, 1997; Willatts, 1990), cognitive processes that are used in problem solving can be seen as a compendium of overlapping skills (the mechanics of problem solving) that mature into 'well-trodden paths' (Siegler 1998, p. 260). These skills include:

- The ability to make connections
- Manipulation of objects
- Marshalling assistance from more knowledgeable others
- The ability to use tools

(Adapted from Sielger and Alibali, 2005)

These skills, Gopnik *et al* (2000), amongst others (Willatts, 1990; Brierley, 1976), maintain are present in an infant's earliest months, but are constrained by the immaturity of the information-processing system, memory capacity, attention, motivation and physical control of body parts.

Essentially, as Goswami (2010) concludes, research is confirming that very young children do have the ability to solve problems. Lumsdaine and Lumsdaine (1995) acknowledge children's ability to be creative in their problem solving. Creativity in the context of problem solving is seen as:

> An idea that has an element of newness or uniqueness, at least to the one who creates the solution. (p. 5)

Goldschmied and Jackson (2004) link creativity in children under three to the exploration and use of materials, an activity Brierley (1994) suggests has a considerable influence on the growth of all later intellectual skills. Goldschmied and Jackson (2004) in their description of heuristic play acknowledge that there is no right or wrong way to use materials and that very young children use materials in different ways, either as a means of increasing their knowledge of the possible properties of materials, or, as Chen *et al* (2000) suggest, of experimenting with the use of tools.

Hutt (1966) points out that most definitions of exploratory behaviour have tended to be over-inclusive and 'hardly operationally useful' definitions (p. 203). Hutt (1966) draws some distinction between exploratory behaviour and investigation and concludes that exploration involves inquisitiveness, that the investigation is determined by the nature of the object and that the goal is 'getting to know the properties' (p. 211). Between exploratory and problem solving behaviour, there are overlaps. As Caruso (1990) highlights:

> In both, children are finding out about objects - their properties, what happens when you do things to them, what they can represent, how they can be used creatively and how they work. (p. 27)

Bruner (1990) suggests that exploratory behaviour evolves into problem solving when 'intentions' are present. These 'intentions' feature:

- Anticipation of the outcome of an act
- Selection of the appropriate means for achievement
- Sustained direction
- A stop order defined by the end state

(Adapted from Bruner, 1990)

However, difficulties arise in determining how cognition and creativity are linked with strategic problem solving. As previously noted in chapter two, definitions of what a 'strategy' consists of vary amongst researchers. If it is seen as a pattern or patterns of action (Bruner *et al* 1956), Siegler (1995) argues that its development is not necessarily sequential. Siegler (2005) further argues that one pattern of action or experience builds upon another, and points out that children (and adults) will often cease to use a known successful problem solving strategy and will adopt a new one, which may or may not be successful. Siegler's (2005) research findings show that change in strategy use is gradual, as older and frequently used strategies often continue to be employed after newer strategies are introduced and understood. The question is, as Willatts (1990) in the context of his research of the problem solving strategies of children under two asks, if problem solving is approached in a disorganised way, is it still problem solving?

Willatts (1990), reflecting on his research, concludes that the apparent lack of systematic strategy use does not always result in trial and error being adopted or that problem solving is not taking place. Ruff, Saltarelli, Capozzoli and Dubiner (1992) partially disagree with this as they feel that very young children 'rest' when alert more often than adults acknowledge. Nevertheless, research evidence is currently defining problem solving as an active cognitive process involving, as reiterated by Evangelou *et al.* (2009), a web of multiple cognitive strands 'with different children following different pathways' (p. 4).

Although Siegler (2005), like Piaget (1983), champions the role of cognitive processes in the development of strategic thinking, Siegler (2005) is quite clear that children's choice of problem solving strategy is influenced by the social context in which the problem is located and by engagement with others. This is reaffirmed in the research of Arnold (2010) evidencing how children's cognitive actions, particularly their adoption of one schema over another, are influenced by the emotional events in their lives.

Locating problem solving in a social context

Rogoff (1990) argues that what constitutes problem solving and the types of support mechanisms offered to the problem solver are embedded in and reflect cultural values:

> The structure of problems that humans attempt to solve, the knowledge base that provides resources, and strategies for solution that are considered more or less effective or sophisticated are situated in a social matrix of purposes and values. (p. 61)

As Rogoff and Lave (1999) point out, problem solving does not take place in a vacuum. Cultural contexts can dictate not only what is seen to constitute a problem but the support offered to the problem solver. An acknowledged central feature of this support is interaction with other people (Rogoff and Lave, 1999; Rogoff, 1990) and particularly the role of the 'knowledgeable other' (Vygotsky, 1978).

The role of the knowledgeable other

As previously documented in chapter two, Vygotsky (1978) describes adults' and children's more capable peers who support children's learning as 'knowledgeable others'. In this capacity, they are both instructors and role models, closing the gap between what children can do alone and what they can do with the help of someone more skilled and experienced.

Siegler (2005) maintains that an important part of the adult/child relationship is the support offered by adults through instruction. Lumsdaine and Lumsdaine (1995), in the context of problem solving in a primary classroom environment, describe the role of the teacher as a provider of interactive and procedural instruction. In an interactive context the teacher is a source of experience that prompts discussion and feedback and, in so doing, transmits values. Procedurally, the teacher models skills, provides opportunities for children to practise and consolidate skills, and tests their understanding. Smith (1987) importantly suggests that teachers who are confident in their own problem solving skills are more likely to engage children in problem solving activities.

Reiterating the discussion in chapter two, I acknowledge here the wide range of research showing ways in which adults adopt and use scaffolding strategies (Berk and Winster, 1995; Vygotsky, 1978; Wood *et al*, 1976) or guided participation (Rogoff, 1990). One example of an adult scaffolding strategy, which has been identified as 'the practice most predictive of children's progress' (Sylva and Taylor, 2006, p, 172), is that of sustained shared thinking (Siraj-Blatchford *et al*, 2002).

Sustained shared thinking as an example of adult support of children's thinking.

The use of sustained shared thinking (Siraj-Blatchford *et al*, 2002) was explored in the Effective Provision of Pre-School Education (EPPE) project (Siraj-Blatchford *et al*, 2003). As a model of adult interaction, it is closely related, as Sylva and Taylor (2006) acknowledge, to Bruner's (1997) 'joint involvement episodes' (p. 9).

During the EPPE project the use of sustained shared thinking was seen as an approach that gave 'value added to children's developmental progression' (Siraj-Blatchford *et al*, 2002 p. 39). It is generally seen to be at its most effective when children initiate the activity; it is also seen as a framework that guides practitioners' styles of intervention and their use of questioning (Siraj-Blatchford and Manni, 2008) in adult-led activities.

The availability of the key person to young children, both physically and emotionally, has been identified as an important factor in creating and sustaining shared thinking, which Siraj-Blatchford *et al* (2003) define as:

> An effective pedagogic interaction, where two or more individuals 'work together' in an intellectual way to solve a problem, clarify a concept, evaluate activities, or extend narrative. (p. 23)

Siraj-Blatchford *et al* (2002) maintain that communication, collaboration and creativity are essential elements of effective adult support of young children's learning. To initiate and sustain what Siraj-Blatchford (2007) later terms as the 'three C's', the supporting adult is required to adopt the following strategies:

- Show genuine interest in the children
- Offer own experiences
- Clarify ideas
- Suggest
- Remind
- Re-cap
- Use encouragement to further children's thinking
- Offer alternative viewpoints
- Speculate
- Reciprocate
- Ask open questions
- Model thinking
- Use positive questioning
- Use 'making sense' words e.g. 'I think', 'I wonder'
- Respect decisions and choices of children by inviting them to elaborate

(Adapted from Siraj-Blatchford, 2007)

However, in the use of sustained shared thinking there is a caveat. The strategies are effective only if they are attuned to children's patterns of learning (Siraj-Blatchford, 2005). Additionally, over-reliance on one or two strategies 'depresses' children's learning rather than supports it (Siraj-Blatchford and Manni, 2008). This is particularly relevant in supporting children's problem solving where, as Whitebread *et al* (2004), report the over-use of questions by an adult with older pre-school children can reduce their thinking time and was felt to erode children's self-confidence.

Siraj-Blatchford (2007) acknowledges that sustained shared thinking, which has a strong theoretical resonance with Vygotskyian theory, looks different in its use with children under three years from that with older children. Instead of relying on verbal language the practitioner has to be guided by the infants' expressions and body language. These are perhaps best illustrated by the criteria for good practice in supporting the thinking

and understanding of children under three arising from the Everyday Stories evaluation framework (Selleck and Elfer, 1977). These criteria contain some important messages and so are worthy of full referencing.

Table 3:1: The `tutorial' for children's thinking and understanding

The `tutorial' for children's thinking and understanding

Criteria of good practice

- Interactions between children and key persons are mainly characterized by unhurried conversational exchanges. These interactions, in which the child's communication is listened to thoughtfully, and the adults' responses are based on the communication and knowledge of the child's observed interests and concerns are designed to support and further the child's continued thinking and understanding. This interaction will be matched to the child's pace and rhythm, their capabilities and interests.

- There is time for children to be alone for private reflection, self-talk, dreaming and imagining, and this time for children to think is respected and understood by the adults. The nursery routine is not so adult directed that it leaves no time or space for such learning opportunities for children.

(Selleck and Elfer, 1997)

What this tutorial for good practice, quoted verbatim, so clearly illustrates is that very young children's learning involves a reciprocal and emotionally close relationship with their allocated key person. In my study I utilise what I consider to be the unique role of children's key person to help me analyse the children's problem solving. This analysis includes the emotional support given by them, that Evangelou *et al* (2009) see as so necessary to children's development as successful learners.

The importance of the emotional domain in very young children's learning

The concept of emotional support, which Evangelou *et al* (2009) describe

as 'contingent responding', reinforces the link between the development of emotional relationships and cognitive development that research is clearly indicating (Evangelou *et al*, 2009; Rutter *et al* 2007; David *et al*, 2003; Schore, 2001; Brierley, 1976). Schore (2001) describes child/adult interaction in terms of engagement, coordinated disengagement and re-engagement and maintains that this 'mutually attuned synchronization' (p. 9) facilitates information processing by adjusting the mode, amount, variability and timing of stimulation. This creates a 'give and take' relationship that Stern (1998) and others (Evangelou *et al*, 2009) describes as 'attunement', defining this as:

> An empathetic responsiveness between two individuals, which subtly conveys a shared emotion. (Stern, 1998, p. 10)

This emotional attachment develops as the carer learns what excites, upsets, amuses, or bores children so that interactions can be 'fine tuned' (p. 309), increasing adult sensitivity to the child's emotional, developmental and learning needs. The resultant 'tuning into children' (National Children's Bureau (NCB), 1994) facilitates an interpretation of children's needs which, as David *et al* (2003) show, can make the greatest difference to children's well-being and ability to learn.

Additionally, Raikes's (1993) findings into the relationships between 'high ability teachers' (p. 309) and infants in one nursery setting indicate that teachers who are sensitive to the emotional needs of children create a supportive environment. The emotional security that this environment provides, Raikes (1993) maintains, promotes infant autonomy and the self-confidence to explore independently and to learn about their immediate world. Raikes's (1993) conclusion is supported by longitudinal research data (Degotardi and Pearson, 2009), which indicate that infants who are securely attached to a key person are likely to become 'empathetic, independent and achievement-orientated' (p. 146).

Schore (2001) additionally argues that interaction with an emotionally responsive caregiver may maximise children's positive affective state

by generating excitement, pleasure and joy, which:

> Both deepen bonds and expand the baby's curiosity and interest in the world. (p. 47)

Elfer *et al* (2003) see one of the significant benefits of the key person approach as ensuring that within the day-to-day demands of the nursery each child feels special and individual:

> Cherished and thought about by someone in particular while they are away from home. (p. 18)

Raikes (1993) points out that what emotional attachment looks and feels like for very young children in their nurseries is individual to each child. However, David *et al* (2003) emphasise that young children learn best:

> When they have the opportunities to observe and interact through play and to talk to those who love them. (p. 23)

Invoking a concept of emotional flow between child and carer, Gerhardt (2004) makes the connections to brain research to support her contentions on the importance of love in child development. She draws on a range of supporting studies to suggest that brain development is significantly related to emotional experiences, particularly in the latter half of the first year of life and that different regions of the brain are moulded by socio-emotional experiences at different times during babyhood.

At its most fundamental, the key person's role in supporting young children's learning encompasses an attachment, a reciprocal relationship and elements of sustained shared thinking. Rogoff (1990) sees this as helping children find connections between old and new situations by providing:

- Emotional cues about the nature of the situation
- Models of how to behave
- Meaning of events
- Labels for objects
- Information about similarities across situations

(Adapted from Rogoff, 1990)

The close adult, therefore, takes on the role of the mediator who channels information to the child to engage, stretch and challenge. Children's learning, therefore Rogoff (1990) argues cannot be regarded as 'cold cognition but inherently involves emotion, social relations and social structure' (p. 10).

Supporting young children's learning, however, does not always involve success and progress. The acceptance of this Rogers (1961) sees as part of the process of 'unconditional positive regard' (p. 62), which those adults close to the child accept without reservation and without judgement. This gives babies and very young children, Raikes (1993) proposes, a sense of trust, predictability and control, 'the foundations of later learning' (p. 309).

Concluding Remarks

The conclusion reached in the *Birth to Three Matters* literature review (David *et al*, 2003) is relevant. The authors state that after reviewing over five hundred publications the conclusion may seem obvious and simple, that young children come into the world seemingly programmed to be curious, to learn and to be social. In short, they are natural problem solvers. To this I would like to add that children are problem solvers with emotional needs.

Current neuroscience research findings are confirming very young children's status as active learners and logical thinkers (Muir *et al*, 2008) is not as limited as some theorists – Piaget and others – have claimed. When research methods have been adapted to the younger age groups, particularly in the field of problem solving, children's competencies are recognisable as being closer to those of adults than has been supposed (Baillargeon *et al*, 2009; Chen *et al*, 2000; Willatts, 1990; Stone, Smith and Murphy, 1974).

Alongside supporting cognitive development, equal consideration needs to

be given to support the emotional elements of learning that Bloom *et al* (1964) classify as the affective domain. Carr and Claxton (2002) present, as documented in chapter one, the emotional elements of learning as a series of learning dispositions:

- Taking an interest
- Being involved
- Expressing a point of view or feeling/communication with others
- Taking responsibility
- Persisting despite difficulty or uncertainty

(Adapted from Claxton and Carr, 2004)

These dispositions are seen as a vital element of young children's learning (Brooker, 2011), and are more likely to be developed when children's cognitive and emotional development are nurtured. In the context of my study the children's main carers – their special key people – I would maintain, are in a unique position to do this.

Chapter Four

Research methodology and methods

Introduction

In this chapter, I document the recruitment of the four participating nurseries. This is followed by a consideration of research methodologies and the reasoning that led to my choice of research methods. I then discuss the ethical issues surrounding my adopted role as a non-participant researcher. Finally, I describe the evolution of a framework, which I used in analysing my main study data to answer my two research questions.

Recruitment of four nurseries

The four participating nurseries, including one nursery based in a children's centre used in my pilot study, were recruited through contacts that I had made during previous research (Wailling, 2005). Each nursery was willing to take part in a small-scale research project and identified the advantages of being involved. These included: being able to use involvement as part of its evaluation of early years practice; setting an example to staff considering action research projects and providing additional evidence of good practice for the Office for Standards in Education (Ofsted) (2010) Self Evaluation Form (SEF) for other nurseries in the locality/nursery chain to emulate. All three nurseries had been awarded a 'good' Ofsted judgement at their last inspection, which was constant with previous inspections. All four nurseries used the Infant/Toddler Environmental Rating Scale (ITERS) (Harms, Cryer and Clifford, 1990) to monitor their childcare practice.

Following my initial visit to each setting and e-mail discussions with the four nursery managers, the research schedule was agreed. The nursery based in a children's centre agreed to take part in the pilot study, running from December 2009 to February 2010. This would involve three morning sessions, each of three hours duration. The remaining three nurseries agreed to take part in the main study. We agreed the research schedule by which I would attend each nursery for one morning session (8:30 – 12:30)

over a period of ten months (the average period of time children under three spent with one key person before transfer to a new room and staff team).

Research methodology

A clarification of the use of ethnographic research

The decision to carry out qualitative research was made to set children's problem solving in a real-life context. This was partly to illustrate the children "at work" in their problem solving, and partly to bridge the gap between research and practice. To achieve this I became a non-participant observer whereby I visited the settings and watched the children for short sessions over a period of ten months. I considered this approach to fall within the realms of Hammersley's and Atkinson's (2007) definition of ethnographic research in which the task of the researcher:

> Is to balance a commitment to catch diversity, variability, creativity, and spontaneity of social interactions with a commitment to seek regularities, order and patterns within such diversity. (p. 12).

Hammersley and Atkinson (2007) suggest that the value of ethnography is that it offers the opportunity to:

- Collect data from real world contexts
- Value both researcher and participant perspectives
- Record the emergence of events, taking into account cognitive, social and emotional factors

(Adapted from Hammersley and Atkinson, 2007)

These elements, rather than testing hypotheses, focus attention 'first hand on to everyday events and those components that fuel them' (Delamont, 2002, p. 230). As Buchbinder, Longcroft, Barrett, Lawson and Floresh, (2006) point out, ethnographical research can offer an insight into developmental, social and cultural processes that shape children's developmental pathways. This insight Buchbinder *et al* (2006) argue 'illuminates practice' (p. 47). MacNaughton *et al* (2001) see this in terms of providing fine grain detail which:

> Paints a picture in words, captures a likeness, recreates a feel of an event, evokes an image, awakes a spirit or reconstructs a mood or atmosphere. (p. 194)

Drawing on Hammersley's and Atkinson's (2007) definition of ethnography, Flewitt (2011) outlines three possible approaches to ethnographic research:

- Doing ethnography – a broad in-depth, long term study of a social/cultural group conducted within an anthropological framing

- Adopting an ethnographic approach – a more focussed study of aspects of everyday life and practices of a community

- Using research ethnographic methods and techniques in fieldwork

(Adapted from Flewitt, 2011)

Dicks, Flewitt, Lancaster and Pahl (2011), in their overview of research into the influences of multimodility on early literacy, suggest that these approaches form an ethnographic toolkit that can produce richly detailed accounts of children's 'immersion' into the levels of social complexity, cultural styles, emotions, physical environments, images and sounds. This Ben-Ari (1996) argues enables researchers better to understand how relationships and patterns of learning develop, the value of which in early years research is increasingly acknowledged (MacNaughton, Rolfe and Siraj-Blatchford, 2001).

By implementing an ethnographic approach I was able to adopt Hammersley's and Atkinson's (2007) positioning, that of 'immersion' (p. 30) enabling me to observe closely the children 'at work' problem solving during their nursery day. In doing so, my aim was to provide evidence of the competency of children under three as successful problem solvers. Certainly, adopting an ethnographic approach gave me time to build up a portfolio of observations showing children 'at work' problem solving. It also gave me time to build up a relationship with the children's key person and to a certain extent with the children themselves. The relationship with the children's key person was important, as I have previously documented. I wanted to utilise their knowledge about the

children and explore their support of the children's problem solving. Additionally, as discussed in chapter one, I was aware of the need to capture the ways in which the children approached problem solving as a means of raising the level of discussion about the children's problem solving strategies.

The use of observation as a research method

The type of observations made during my main study, in the words of Mukherji and Albon (2010), can be described as 'narrative observations', 'descriptive narratives' or 'running records'. As Mukherji and Albon (2010) acknowledge, although making an observation appears to be a reasonably straightforward research method, it is 'by no means an easy skill to acquire' (p. 108). Rustin (1989) also reflects that in making observations the researcher needs 'the capacity to tolerate anxiety, uncertainty, discomfort, helplessness, a sense of bombardment' (p. 20) – all felt during my main study period, alongside a sense of excitement.

The excitement that I felt was generated by the dazzling speed of children's actions, by the unpredictability of their choices and by their changing moods. As David *et al* (2003) write:

> Observing children when they play in familiar surroundings is not only enjoyable, because it is during play that children are relaxed enough to 'perform' in ways which demonstrate the amazing extent of what they know and can see. (p. 104)

The advantages of using observations as a research method appeared to be clear. I would be able to record examples of problem solving, capture its momentum and children's choices. However, there are acknowledged disadvantages of using observations as a research method, one being, as Wolcott (1981) recognised, the presence of bias even if the positioning of the researcher is made clear. Wolcott (1981) also points out that to recognise the risk and possible presence of bias, may add texture to a study, rather than detract from it.

Certainly, the discussion contained in chapter one about the major influences on my thinking was purposely set out early in the thesis to acknowledge the fact that I have a strong interest in Athey's research (1990; 2007), and that as a consequence I tend to see children's schemas everywhere. Being aware of this bias does, however, help me in my use of critical reflection.

During analysis of my field observations, it became apparent that one major area in which careful reflection was needed lay in my eagerness to illustrate the children as competent learners. In the light of this it is interesting to note that in my observations children's seemingly 'failed attempts' to solve a problem are not described as such but are couched in, or hidden by, terms such as 'preliminary random exploration', 'distracted away from task'. Seemingly, I am ready to acknowledge the competent child but not the incompetent one.

In this example it is the evaluation of data that is biased, and not the recording of children's play. What the use of observation as a research method gave were snapshot pictures of children 'at work' solving problems, along with the salient features of their problem solving behaviour. The next decision to make was to decide on how many children to observe and how to schedule my observations.

It became evident during the piloting period (three sessions of three hours each) that to gain what James (2007) describes as the detailed 'fine grain description' (p. 53) I needed in exploring my two research questions, I should focus on specific children rather than rely on random observations of groups. In effect, my study would be based on a case study.

Using a case study as a research method

Grieg, Taylor and MacKay (2007) define a case study as:

> An investigation of an individual, a family, a group, an institution, a community or even a resource, programme or intervention. (p.145)

Nisbet and Watt (1984) highlighted the following advantages in using a case study:

- The results are more easily understood by a wide audience (including non-academics) as they are frequently written in every day non-professional language
- They are immediately intelligible – they speak for themselves
- They catch unique features that may otherwise be lost in a larger scale survey
- They can embrace and build in unanticipated events and uncontrolled variables

(Adapted from Nisbet and Watt, 1984)

These advantages seemed pertinent to my study. I wanted it to be understood by early years practitioners, particularly because, as discussed in chapter Three, much of the literature about children's problem solving appeals to a specialist audience. I wanted to be able to celebrate very young children as problem solvers and, therefore, to capture those special moments that displayed glimpses of the children's brilliance during periods of problem solving that might have been lost using a larger sample group.

However, I am aware of the disadvantages of case studies as highlighted by Bassey (1999):

- The results may not be generalised except where other readers see their application
- Case studies are not easily open to cross-checking and may therefore be selective, biased, personal and subjective
- Case studies are prone to problems of observer bias despite attempts made to address reflexivity

(Adapted from Bassey, 1999)

However, on balance, these disadvantages did not prevail in my mind, as they were not wholly inevitable; rather, they were risks to be minimised by constant and proactive awareness. My use of a case study as a research method appeared to have the potential, which Yin (1994) points out, to

yield descriptive, exploratory and explanatory data offering 'an insight into the real dynamics of situations and people' (p.185).

Consideration of other research methods

Could my two research questions have been addressed through another research method? Reflective diaries combined with observations completed by the children's key person would have generated data that recorded the children's problem solving and adult perceptions of problem solving events. This would have been particularly useful when analysing adult-led problem solving activities in terms of children's interest, engagement and learning. Approaching staff to keep reflective diaries was considered at initial discussions with the managers of the three nurseries directly involved in the main study.

Practitioners were encouraged to keep reflective diaries for one month during the pilot study and the outcome discussed with the nursery manager. The manager reported that the staff team were reluctant to keep a reflective diary as they found it very time consuming. It was also felt by the manager that observing in depth one aspect of children's learning – problem solving – would require orchestration of staff, as well as limiting observations made on other areas of learning. Additionally, although making observations of children's play was a tool used by all the practitioners in the study, observations (and their evaluation) were not shared outside the immediate nursery environment. She also felt that staff would be reticent about sharing observations with an outside researcher.

The manager stated that practitioners would also need guidance on what types of scenarios to observe, and as Wolcott (1981) points out, what to look for, what to record and how to record it. She concluded that observations focusing on the key person's support of children's problem solving would also involve peer observations, which in all four nurseries were not yet well established. The manager felt that peer observations needed 'careful handling', as there was a fine line between constructive

and destructive criticism in a workplace where feelings amongst staff could 'run high' because of the emotional demands of the job.

These concerns were discussed with the other three managers involved in my study who all agreed that the adoption of an ethnographic approach in which I would be a non-participant observer appeared to be the way forward.

My role as a (nearly) non-participant researcher

When making observations it was agreed that I would sit close to the children but not participate in their activities. First, this would allow me directly to see and hear children's play. Second, as Elfer and Selleck (1999) describe, free of the day-to-day responsibilities of running the nursery, I would be emotionally and intellectually more available to record evidence. In an earlier research project, observing children under three in their nurseries, Selleck and Elfer (1978) wrote:

> So whilst endeavouring not to engage with children or to enter into my relationship with them, we have actively sought to use our capacity to be empathetic to consider how the children made us feel as well as what they made us think – as a rich source of data. (p. 72)

However, right from the start I found it difficult and sometimes impossible to be neutral and 'invisible'. I do engage with children; I can't help it. In my personal research journal I wrote:

Box 4.1: Researcher neutrality - extract from research journal, January, 2010

> Researcher neutrality
>
> In the interactive atmosphere of a nursery adopting a neutral and withdrawn position is not only difficult, it is insensitive. To return the smile of a baby or to accept a toddler's gift of bricks or, on one occasion, used tissues tucked in my pocket, feels right.
>
> (Extract from research journal, January, 2010)

However, as the main study progressed, although there were occasions when I interacted with children and staff, this appeared to be balanced with periods when I was quietly observing and recording. This led to a comment by Kate, a practitioner involved in my study, who described me to visiting parents as 'Kim, our researcher, she sits in the corner', later adding that information about me was on the parents' notice board. As previously noted, it would have been unrealistic for me to adopt a neutral position. There were also occasions, when, I stepped in as a 'watchful adult' rather than a neutral researcher, to 'confiscate' a potentially harmful object (a pair of metal scissors) and to prevent or 'cushion' a fall. My interventions were fuelled by my judgements about safety, not only as a researcher but also as an early years practitioner and parent. Issues about children's safety during periods of problem solving are discussed again in chapter five, as there is a fine line between encouraging children to explore and 'take risks' in their problem solving and ensuring their safety.

Throughout, in my role as a (nearly) non-participant researcher my intention was to form a reciprocal relationship with the research participants: the children, their families and the staff in the children's nurseries. Fine (1994) highlights the importance of a reciprocal relationship describing it as 'working the hyphen' (p. 231), which has the aim of narrowing the gap between the researchers and researched so that the researched are not seen as a distant and separate other. However, Lahman (2008) strongly argues that research participants, particularly children are 'always othered' (unfamiliar and distinct), which is 'inescapably dreadful' (p. 282). However, this should not stop researchers from attempting to form a respectful relationship with the objects of their research.

Creating an ethical and respectful research environment

Consideration of ethical issues is paramount to protect the well-being of the research participants (Denzin and Lincoln, 2000) and evidence that this has been done needs to be present in all aspects of the research process. Although I accept the viewpoint of Patis (1994) 'that in an

unethical world we cannot do truly ethical research' (p. 187), it is important to be realistic and proportionate.

Campbell (2008) argues that there are risks of research ethics being applied ineffectively and of reflecting double standards. For example, Campbell (2008) suggests the presence of 'gatekeepers' (p. 23) (adults who make the initial decision as to whether a child should participate in a research project) may lead to an underestimation of the resilience of children and treat them as the property of adults. In this light, it was important for me as a researcher to keep a record of the evidence showing how ethical issues had been considered throughout my research project. To be systematic I decided to group my thinking and actions into five areas that I felt were best suited to the design and conduct of my research and the analysis of my findings. These four areas were:

- Minimising the risks to participants in the research design and where appropriate offering choice and options
- Consideration and management of power relationships
- Showing awareness and respect for the potential diversity of prospective participants
- Paying attention to communications within the research process

(Adapted from Cohen *et al*, 2007)

I agree with Sieber (1993) that research ethics are about the application of moral principles to prevent harming or wronging others. They are also, as Sieber (1993) writes, to 'promote the good, to be respectful and to be fair' (p. 14). In the light of this it was important, therefore, to give thought to the implications of my role as a researcher and to the balance of power within the relationships.

Consideration of power relationships in research

Mishna, Antle and Regehr (2004) maintain that despite attempts to equalise power between the researchers and the researched there remains an inherent power imbalance 'in which the researcher has the distinct advantage' (p. 456). First, research conducted within an institution under the auspices of a university or government agency imbues the researcher

with a status that research participants feel unable to challenge. It may have been presumptuous or naive to assume that I as an outside researcher would be accepted as a 'trusted peer', but it was on that premise that I entered the nurseries. I did not see this status as a ploy, which Oakley (1981) warns against using as a tactic to manipulate, influence and control. Certainly, a concern that I held was that I was unsure how much pressure the four nursery managers had exerted on practitioners and parents to agree to the children's participation in the study. To address this I made clear to all participants that they could withdraw at any time without being asked or put under any kind of pressure to give reasons, although Mishna *et al* (2004) argue that this 'get out clause' (p. 23) can be seen by research participants as a sign of failure rather than an expression of their right to withdraw.

Throughout the period of my field research, I aimed to build relationships with the children, their parents and early years practitioners that were respectful and in which empathy, explanation and openness were the key components. At times, reassurance came into play because, as my research journal recorded, the 'watched' became aware of the 'watcher':

Box 4. 2: Consideration of power relationships between the researcher and the researched – extract from research journal February, 2010

> Consideration of power relationships
> Paddy waited for me to smile at him almost as a sign of 'it's ok to do that' before emptying the box of dressing up clothes – an empty box was needed to climb on to reach his comforter – which he is discouraged from doing. I wonder if practitioners also look to me for a smile of reassurance when they do something that they feel I may disapprove of?
> (Extract from research journal February, 2010)

A second point that Mishna *et al* (2004) make regarding power relationships in research is that the effectiveness of the researcher in placing research participants at ease may affect their capacity to protect their privacy, in that information is disclosed that they might otherwise

not have intended to share (which may however, on occasion provide interesting insights). This is a difficult area to assess. During my conversations with early years practitioners there were occasions, particularly during the latter stages of the main study, when practitioners began conversations with pre-emptive statements, such as 'I know I shouldn't say this but…' and 'Honestly, this is just what I think, not the others, not the nursery'. When a practitioner's comment appeared to me to be sensitive, I would ask if it was 'for the record'. If the reply was 'no', I asked for permission to make a non-attributable note in my research journal. If the practitioner's reply was still 'no', I respected it and while not making a written record was aware that the comments were stored in my memories of conversations which inevitability influenced, consciously or not, further thinking.

Although adhering to the University's ethical code of conduct (The University of Sheffield, 2010), which clearly upholds the right of anonymity, the interpretation of the code remains with me, the researcher. It is in this interpretation of ethical codes that, I would argue, researchers have the distinct advantage in the research power relationship. However, responsible exercise of professional duty can lead to an erosion of trust as a result of perceived abuse of power, which occurred after I had witnessed an incident of what I considered to be inappropriate practice.

During the main study I once found myself in a position in which I needed to bring an issue bearing on duty of care to the attention of a nursery manager. I had observed and recorded an event that I considered to be inappropriate early years practice on the part of an adult towards a child under one. At the end of the session I asked the manager to read my observation and to contact me if she wished to talk about the matter. The issue was resolved successfully, but not without consequences. On subsequent visits to the nursery I was acutely aware that the relationship with the nursery staff had changed. I was aware of a shifting in their attitudes towards me and I was no longer seen as the 'friendly researcher'; mistrust, which eventually resulted in a practitioner withdrawing from the

study, overshadowed my relationship with the nursery team. However, to draw the manager's attention to inappropriate practice was right, given the paramount importance of the children's welfare and well-being.

I drew a further conclusion from this experience: although it was right to strive for objectivity, neutrality and equality of power, it would be, as Misha *et al* (2004) argue, impossible to eliminate power imbalance. However, the important thing was to recognise it where it occurred and to acknowledge its effects in every aspect of my research. In this context I saw it as part of the two processes of reflection and reflectivity that Finley and Gough (2003) see as being distinct from each other. They see the former as occurring after experience and the latter before, during and after. Hertz (1997) sees the reflective researcher as one who asks questions and understands that in reaching conclusions they are not writing truth *per se*, but are constructing interpretations to be further probed and reconstructed. As Denzin and Lincoln (2000) state:

> There is no clear window into the inner life of an individual; any gaze is always filtered through the lens of language, gender, social class, race and ethnicity. (p.19)

Furthermore, Lahman (2008) argues that reflexivity is one of the most vital constructs in research. Finley and Gough (2003) describe it as the process of bending back upon oneself describing it as 'a thoughtful self-awareness between the researcher and the researched' (p. ix). However, I paid heed to Fine, Weis, Weseen and Wond's (2000) caution not to slip into obsession and self-absorption and to keep the focus on the purpose of my research and the two research questions.

Recruitment of research participants and the importance of paying attention to communications within the research process

Recruitment of research participants

As previously noted, the four participating nurseries were recruited through contacts that I had made during a previous research study (Wailling, 2005). Before the start of the main study, discussions with the three nursery managers involved outlining the purpose of the study and

observation timetable, as well as sharing information, and seeking their views, about the ethical practice including the distribution of consent forms to the parents of children involved in the study and the children's key person. The three nursery managers involved in the main study initially calculated how many children under three were currently attending and were likely to continue to attend for the coming year. Following this, a group of children who would be still under three at the end of my main study (October, 2010) were identified and their key person approached to gauge their potential interest. It was agreed that both children and early years practitioners would be identified by pseudonyms, which it was agreed would be of their own choosing. Most practitioners adopted the names of celebrities while many the parents of the children opted for names of other family members including grandparents.

Children who would be still under three at the end of my main study (October, 2010) were identified and their key person approached by the nursery managers to gauge their potential interest. Ten children and their key person agreed to take part in my study. This included two older children, Sam and Jossie, who both reached their third birthdays before the end of the study, as Caroline and Katie, the children's allocated key persons, were keen to participate.

Paying attention to communications within the research process

I provided an information sheet about my study, outlining its aims and what involvement would mean. The managers also offered families the opportunity to discuss my study with them informally and gave them my e-mail address so that further information could be gained. Families were given consent forms to complete. These were all returned to the nursery managers who acted as 'go betweens' for the children's families and myself.

Initially I had offered to hold a parents' meeting before the start of the study to strengthen communication between the children's families and myself. However, the nursery managers felt that this was impractical as

each child was collected at a different time and many of the children's parents would find it difficult to attend an 'out of hours' meeting. To make contact with each family, it was agreed that I would spend a day in each nursery so that I could be introduced to participating families. Most parents were busy at the beginning of the sessions but were happy to chat about their children and my study and to ask questions at the end of the day.

What was striking was the trust that the parents placed in the judgements of the nursery managers. Although I did talk to parents about how I adhered to ethical research guidelines the fact that the study had been given the go ahead from the nursery managers seemed to be sufficient evidence that my research practices were 'safe'. So, just as the parents acted as 'gatekeepers' (Campbell, 2008, p. 23) in terms of consent for their children, the nursery managers acted as what Nutbrown (2011) describes as 'guardians':

> In that their role is not so much simply to keep us out or let us in - but their responsibility is, to an extent, to be healthily suspicious of researchers - and to ask searching questions of our intent. (p. 12)

The three nursery managers involved themselves in my main study and did indeed ask the 'why, what and how' questions that Nutbrown (2011) sees as part of their role as guardians of children's interests and well-being. The most common questions posed by the nursery managers were about the immediate and future impact of my study and the benefits it might bring to children and staff development.

Parents asked why their child had been chosen to take part and generally felt that their child's participation in the study would be beneficial. However, these benefits were not seen in terms of their child's development but as a means of gaining information about their child's nursery experiences. Many parents appeared to like the idea that their child would be 'special' to someone else, albeit for a short period of time, as the following extracts from my research journal notes show:

Box 4. 3: The feelings of two mothers about their child's involvement in my study - extracts from research journal February, 2010

> 'She will be treated as special – that's nice really – I think she is special so I like you already as you think she is also special – it will be nice to talk and read about her life in nursery – I miss out so much – so that will be special'.
>
> (*Flo's mum, February, 2010*)
>
> 'I miss out what he does, as I work, even though I work in the nursery, so to find out a little bit more will be good. I think problem solving is a pretty weird thing to study, I hope you don't mind, I think listening to his words would be more helpful or the way he plays with others or if he is making friends'.
>
> (*Paul's mum, February, 2010*)

All parents agreed to release their telephone numbers and e-mail addresses so that I could update them on the progress of the study. It was agreed that an end of study meeting would take place in children's nurseries to discuss provisional findings. One observation of each child involved in a problem solving activity would be copied and offered to the families as a record of the child's participation. One parent (during the pilot study) requested that a summary sheet outlining the final findings be made available to them, which was agreed and subsequently offered to all parents.

As my two research questions were not focused on the children's families but on the children themselves and their key person, the level of contact I had with families appeared, in hindsight, to be proportionate. There was no doubt that communication with the children's parents was essential. However, the main influences on research design and analysis of findings came from my relationship and communications with the children's key person.

Managers initially approached each of the children's key persons to gauge their level of interest. Those practitioners who were happy to take part in my study were given a consent form to complete, to be collected before

the study started. An initial 'out-of-hours' meeting was arranged in two nurseries. At the remaining nursery, I introduced myself to the children's key person and an outline of my study was discussed over the lunchtime period. Some practitioners expressed a concern that involvement might result in extra work, as the following extract taken from a conversation with an early years practitioner shows.

Box: 4. 4: One practitioner's feelings about being involved in my study - extract from research journal February, 2010

> 'I'll take part as long as I don't have to do any written stuff as I am just no good at that and there is no time really to do it – it's so busy all the time – that's how it should be although we do take time to talk so talking will be fine – I will really enjoy that'
> (*Early years practitioner and key person, February, 2010)*

During the first meeting I explained that I would be responsible for recording children's play activities but stressed that as the children's key person knew the children far better than I did, I would be drawing on their knowledge to help with my analysis of observations. It was agreed that I would take notes of these conversations and sometimes write the wording verbatim so as not to lose their meaning.

One early years practitioner offered her e-mail address, so that conversations could take place on-line as she felt she would be too busy to talk to me during the nursery morning. Other practitioners took time in their coffee and lunchtime breaks to talk over observations that I had made during the morning. Occasionally, during the nursery session, a conversation would take place as practitioners put their thoughts into words whilst playing or sitting with the children.

Although practitioners were familiar with written observations some of them expressed concern that any video recordings would show them in a 'bad light' and capture only part of their interactions with children. This Summerfield (1983) maintains can be a potential disadvantage of the use

of video recording as an observation tool, as it is easy to make the assumption that the video camera sees what the human eye sees. As a concession to practitioners' sensitivities, it was initially agreed that all video recordings would be shared with them and although for academic purposes the sequences contained in them would be used unedited, some editing would take place if they were shared with the children's parents. Following this agreement, on further reflection, I became concerned that in editing video and written observations before sharing them with parents I was falsely representing the children's lives whilst attending their nurseries.

At subsequent meetings with all the three nursery managers, this concern was discussed. Although the managers felt that some reservations still existed amongst their staff, it was agreed that the inevitable consequence of the nature of my research was that atypical situations would be recorded and shared with parents on request. At these meetings it was also agreed that video recordings would be carried out using a hand-held camcorder. This would be used on an 'if and when' basis to capture specific episodes of problem solving. Staff in all three nurseries appeared to be wary of video recording, a concern that Flewitt (2006) also encountered in her study of young children, their carers and parents. One practitioner attributed her wariness to her experience of working in a nursery that had closed circuit television (CCTV) located in all rooms. She stated that she felt like a contestant in a TV reality show and performed for the camera. The impact of this, she felt, was that her relationship with her key children lacked warmth which she described as 'the personal touch' and which was replaced by 'false interactions' which she thought the viewers of the CTTV recordings (nursery management and the children's parents) wanted to see, a feature that Summerfield (1984) states influences the validity of the use of video recording as the sole use of data collection.

Some parents also had doubts that they discussed with the nursery managers. Paul's mum was uneasy about him being video recorded, as she feared that images of him would appear on the Internet. This was a very real concern for her as she had recently left an abusive relationship and moved to a new area. It was agreed that visual images of Paul (photographs and video recordings) would not be taken and that recording of his activities would be restricted to written observations. Seven other parents requested that any images of their child should be restricted to research use only and not published in any form. As the main study progressed, children also appeared wary of being video recorded. Children over two often disengaged from tasks when being recorded and walked away. Sam, the eldest of the children in my study, once put his hand against the video lens and shouted 'no'. Sam's action influenced my thinking about the appropriateness of video as a research method and as a result of this I made little use of video recording in Sam's nursery. Younger children appeared to show no displeasure but background noises in the baby rooms often produced poor quality recordings, which were difficult to transcribe.

Flewitt (2006) documents that the use of video recording as a research tool brings its own methodological and ethical dilemmas, particularly about when to stop recording in order to protect participants' anonymity. Flewitt (2006) suggests that rather than following a detailed preconceived code of conduct imposed upon the participants by the researcher, 'provisional consent' (p. 31) should be obtained so that ethical dilemmas that evolve throughout a study can be resolved 'in their local and specific contexts, on a minute-by-minute basis' (p. 31). Interestingly, practitioners did not seem to be wary of my occasional use of a Dictaphone to record our conversations.

Sharing ideas about the research methods and resolving possible areas of conflict became very much part of my study. However, discussion mainly involved the three nursery managers following observation sessions. Sustaining two-way communication with the children's key person,

mainly by informal conversations, was difficult to maintain throughout my study. This was in part because the research schedule, as presented in the next section, did not build in enough time to fully involve and utilise the expertise of the children's key person, a limitation of the study that is discussed in chapter six.

Observation schedule and framework

Observation schedule

Observation schedules at each of the three nurseries took account of the children's patterns of nursery attendance and nursery routines. It was important that each observation session included periods when children were likely to be alert (which Paddy's key person Cheryl described as 'wakefulness'), although at no point in my study were children's daily routines and sleep patterns interrupted.

Table 4.1: Research timetable

Pilot study		December 2009 - February 2010 3 morning sessions, 08.30-12.00
Main study	Nursery A	February 2010 - October 2010 3 morning sessions, 08.30-12.00
	Nursery B	February 2010 - October 2010 3 morning sessions, 08.30-12.00
	Nursery C	February 2010 - October 2010 3 morning sessions, 08.30-12.00

It was agreed that I would observe children's play and focus on problem solving episodes contained within and generated from the children's play. However, during the piloting sessions it became clear to me that to do this I needed to differentiate between different types of activity in a systematic way.

Differentiating between periods of children's activity

As a starting point, basic questions needed to be addressed such as 'What elements constitute play?' and 'When does this differ from periods of

children's involvement in routine tasks?' Drawing on the research of Hutt, Tyler, Hutt and Christophersen (1989) into epistemic and ludic play behaviour I identified children's self-initiated play as periods of activity that contained most of the following characteristics:

- Unconstrained
- Mood dependent
- Has the key features of enjoyment and fantasy
- Has constraints which (when they exist) are imposed by the child
- Idiosyncratic
- Innovative
- Repetitive
- Symbolic (Adapted from Hutt, 1971)

Adult-initiated play was identified by Johnson, Christie and Yawkey's (1999) description as:

> An activity with a planned learning intention, but the way to achieve and record this is left to the children. The adult is the facilitator, who stimulates and enriches the child's experiences, providing the context and the boundaries. (p. 205)

Johnson *et al* (1999) maintain that during adult-initiated play children typically:

- Follow possible suggestions from the adult
- Find challenge through the initial stimulus from the adults
- Stay within the set boundaries as to expected outcomes

In contrast to play sessions, periods of activity that were part of the children's daily routine, such as meal times and tidy-up sessions were not initially part of the observation schedule. However, even with definitions of play in place in the observation schedule, overlaps frequently occurred. Early years practitioners are very good at turning routine activities such as mealtimes into 'playful' activities. Similarly, as Bruce (2001) points out, very young children with their natural enthusiasm for play are 'playful' (p. 7) and do not differentiate between play and other activities.

Identifying periods of problem solving

During the pilot study I attempted to record the children's play continuously throughout the morning session. What resulted were summaries about the children's play that lacked what Geertz (1973) terms 'thick description' (p. 11). This lack of detail posed difficulties in distinguishing between what was, and what was not problem solving. Consequently, I needed to be quite clear about what problem solving 'looked like'.

As previously outlined in chapter one, my study acknowledges that problem solving can be seen as creative, self-generated and embedded in an organic process of enquiry and learning (Taggert *et al*, 2005). These features appear to be similar to the characteristics of very young children's heuristic play, as defined by Goldschmied and Jackson (2004), which in turn resonate with Pólya's (1956) account of a successful adult problem solver.

Although Goldschmied and Jackson (2004) present heuristic play not as a classification of play but as an approach to learning, they do give examples of two types of play that are seen to promote it. First, treasure basket play (Goldschmied and Jackson, 2004, p.198), discussed later in chapter five, is seen as appropriate for babies who can sit independently but not yet crawl. Second, heuristic play with objects (Goldschmied and Jackson, 2004, p.187) is seen as suitable for use with more mobile infants in their second year of life. Both are seen as involving spontaneous, exploratory activity, which serves the child in the reaching of conclusions and their understanding of events (Goldschmied and Jackson, 2004). Hutt (1971) describes similar characteristics as elements of epistemic playful behaviour, which Pólya (1956) in a more sophisticated way highlights as successful problem solving strategies for adults – namely the ability to understand the problem, devise a plan to solve it and review the solution obtained.

Drawing on and adapting the characteristics of heuristic play, as defined by Goldschmied and Jackson (2004), combined with Pólya (1956), problem solving strategies for adults provided me with an initial list of possible key features of young children's problem solving namely:

- Children working with purpose and engagement
- Internal logic (evidence of plan, do and review)
- Creativity
- No right or wrong use of materials

(Adapted from Goldschmied and Jackson, 2004; Pólya, 1956)

These core characteristics guided my observations (and later analysis). Some characteristics, such as children working with purpose and engagement, were easier to identify than others. For example, I was already familiar with and experienced in observing children's engagement with play activities, albeit with older children because of previous involvement as an early years practitioner in the Effective Early Learning (EEL) project (Pascal *et al*, 1996). I also had a working knowledge of the research of Laevers and Heylen (2003) that demonstrated the ability of young children to play with a deep and sustained level of involvement.

However, assessing what constitutes a more abstract characteristic such as 'inner logic' required further clarification. Skemp (1986) provided a useful reference in describing inner logic when applied to problem solving:

> A relational understanding that determines how to approach a problem and how to effectively draw on resources to solve it. (p. 11)

These abilities resonated with the approach of 'planning, monitoring and evaluation', a procedure that Gura (1992) found was used by pre-school children in problem solving during block play. Muir *et al* (2008) shorten these tactical behaviours to 'plan, do and review'. Their use, I concluded, was possibly a way of seeing inner logic in terms of young children's actions. It is important that my use of the term 'plan, do and review' in describing inner logic is not confused with the routine of the High Scope curriculum (Weikart, Epstein, Schweinhart and Bond, 1978).

In the context of my study, the concept of 'plan, do and review' is used to illustrate very young children's ability to:

- Interpret information (Willatts, 1990)
- Recognise and frame a problem (Lambert, 2000)
- Plan and work methodically (Muir *et al*, 2008)
- Restructure - go back a few steps and try something else (Lambert, 2000)
- Try alternative strategies, even when existing ones are successful (Siegler, 1996)
- Use of range of strategies (Siegler, 1996)
- Repeat an activity when unsuccessful (Willatts, 1997)
- Have the motivation to persist (Claxton and Carr, 2004)
- Enjoy the act of problem solving (Claxton and Carr, 2004)
- Detect and use information about their failure to solve a problem to make further attempts (Chen *et al*, 2000)
- Being purposeful and deliberate – which Lambert (2000) refers to as 'planfulness' (p. 6)

Alongside the ability to 'plan, do and review' as discussed in chapter three, is the acknowledged ability of children to be creative in their problem solving (Lumsdaine and Lumsdaine, 1995).

To summarise, in the context of my study children's problem solving was identified with reference to a series of characteristics namely:

- Children working with purpose and engagement
- Internal logic (evidence of plan, do and review)
- Creativity
- No right or wrong use of materials

These four characteristics were incorporated into an analytical framework discussed in the next section of this chapter.

Analytical Framework

Hammersley and Atkinson (2007) reinforce the view that ethnographic research analysis is not a distinct stage of the research and that it begins in the pre-fieldwork phase and continues. The bringing together of my

analytic framework was gradual and evolved from my readings about the definitions of problem solving, what is known about very young children as problem solvers and how this is supported, as well as the experiences gained throughout the pilot study. I was also aware, however, as Hammersley and Atkinson (2007) warn, that the influence of the researcher's existing ideas and of relevant literature in shaping an analysis may lead to prejudgements 'forcing interpretation of the data into their mould rather than being used as resources to make sense of it' (p. 210).

Isolating problem solving episodes within children's play

My proposed characteristics of problem solving - children working with purpose and engagement, evidence of internal logic (plan, do and review), creativity, no right or wrong use of materials - evolved into my first analytical coding framework. This helped me to identify possible problem solving episodes within children's play. So, within each field observation I highlighted the occasions on which each of the four characteristics was present, using Muir *et al*'s (2008) series of tactical behaviours - making decisions, selecting strategies, deciding on a direction and abandoning a direction when appropriate – as an indication of logical thinking. This coding was relatively easy to use on written observations as different coloured highlighters indicated different characteristics. However, coding video recording proved to be more difficult and I found myself resorting to making written accounts of what the video recording contained, rather than reduce the recording to still frames. As a result of this difficulty, and other reasons detailed later in chapter five, the number of video recordings I made fell significantly as the main study progressed.

Although, the use of this first coding framework aided the identification of periods of children's problem solving, it did not address fully my first research question:

- In their nursery settings what are the main ways children under three use to solve problems during their play?

To achieve this, it became clear that the creation of a second coding framework would be necessary. This was based on Siegler's (2005)

research, which as discussed earlier in chapter three identified four skills that children use in their problem solving, namely:

- Manipulation of objects
- Marshalling assistance from more knowledgeable others
- The ability to use tools
- The ability to make connections

(Adapted from Siegler, 2005)

Identifying the ways in which children solve problems

Once episodes of problem solving were identified, this second coding framework was used. Periods of the children's problem solving were consequently scanned and their actions grouped under the four skills. The resultant findings addressed my first research question but not my second, focusing on the support that the children were offered by their key person during problem solving episodes. To highlight this a third coding framework using elements of sustained shared thinking (Siraj-Blatchford *et al*, 2002) was used.

The use of sustained shared thinking as a coding tool

Sustained shared thinking (Siraj-Blatchford *et al*, 2002) is an acknowledged indicator of good pedagogical practice in supporting children's thinking skills (Evangelou *et al* 2009). Although adaptations need to be considered in their use with children under three, the basic principles of sustained shared thinking: communication, collaboration and creativity (Siraj-Blatchford, 2007) appeared to be a useful coding tool.

Furthermore, most of the practitioners involved in the study were familiar with the elements of sustained shared thinking, which provided a common point of reference when discussing my observations with them. As part of the analysis process, each element of sustained shared thinking was colour-coded and matched to the observed child/key person interactions, grouped under the principles of sustained shared thinking:

- Communication
- Collaboration
- Creativity

(Siraj-Blatchford, 2007, p. 1)

As previously noted, sustained shared thinking with children under three years looks different from that with older children. Consequently, identifying aspects of 'contingent responding' (Evangelou *et al*, 2009) was added to the coding framework. This widens the analysis to include the nuances of the child/key person interaction that could be loosely termed 'emotional support'.

Both the proposed observation timetable and analysis framework were adjusted following a pilot study, which took place in a nursery based in a children's centre three months before the main study (December 2009 – February 2010).

Pilot Study

Table 4.2: Research participants involved in the pilot study

Name of Child	Age at the start of the pilot study	Name of key person
Oliver	2 years 9 months	Chantelle (also KP to Armani)
Armani	2 years 6 months	Chantelle (also KP to Oliver)
Rufus	2 years	Samia

Issues arising from the pilot study

At the time of the pilot study no children under the age of two were attending, so the sample consisted of children over two years. The time spent on my study by the nursery staff team was invaluable in:

- Practising my skills as an observer
- Highlighting the benefits of using a case study as a research method
- Sorting out technical glitches with the video recorder
- Piloting and consequent adaptation of research consent forms
- Using my analytical framework
- Working out how best to share the information contained in my observations with practitioners

- Considering how my research could be shared with the children's families
- Keeping updated with EYFS initiatives which also made demands on staff time

Making adjustments in the light of these outcomes to a certain extent fine tuned both my approach in recording children's problem solving episodes and my analysis framework. Analysis of data also necessitated confidence, creativity and experience. It is with these qualities in mind that the next chapter, chapter five, Research analysis and findings, is presented.

Chapter Five

Research analysis and findings

An overview of my study

The purpose of my study is to provide evidence of the ability of ten children under three years of age to solve problems. By analysing a series of observations, an insight into the main ways the ten children under three solved problems is offered. The scope of my study widens to consider the ways in which the children's key person supports their problem solving. To achieve this, chapter six gives examples of the wide range of support that the children's key person offered. Issues arising from these observations are then discussed.

Boundaries to my research

By focusing on the role of the children's key person I am aware that I am omitting the part played by families in supporting their children's learning. My study also does not take full account of the role of more able and older peers, who alongside adults, are 'knowledgeable others' (Vygotsky, 1978) or the intricacies of the interactions between children of the same age (Trevarthen, 2002). The value of these interactions in the nursery environment is acknowledged, particularly in the discussion of the relationship between two children, known here as George and Thomas, where the support of the elder of the two was striking.

Main study

Research participants

Table 5.1: Research participants: Nursery A

Name of Child	Age at the start of the main study	Name of key person
Paul	3 months	Martha (also KP to Bea)
Bea	4 months	Martha (also KP to Paul)
Cassie (Withdrew August, 2010)	6 months	Kylie (Withdrew July)

Jack (Transferred to pre- school room August 2010)	2 years 1 month	Parvinda (KP until August, 2010) Lindy (KP from August, 2010)

Table 5.2: Research participants: Nursery B

Name of child	Age at the start of the main study	Name of key person
Paddy	6 months	Cheryl
Rosie	6 months	Tina
Jossie	2 years 3 months	Katie
Sam (Transferred to primary nursery class April, 2010)	2 years 8 months	Caroline

Table 5.3: Research participants: Nursery C

Name of Child	Age at the start of the main study	Name of key person
George	1 year 10 months	Britney (also KP to Flo)
Flo	4 months	Britney (also KP to George)

In total 10 children under three participated in my main research - five girls and five boys. Nine early years practitioners were also directly involved as well as three nursery managers, Julie, Madeleine and Dolly.

Research analysis and findings

Number of observed episodes of problem solving

A total of one hundred and forty observations of the children at play were made throughout the ten-month main study period, from which the following numbers – 164 in all - of problem solving episodes were extracted. Some observations therefore yielded more than one episode. For the purposes of my research, an 'observation' consisted of a period, averaging fifteen minutes in length, during which I watched and recorded each child at play. I extended the fifteen-minute period in instances where a problem solving episode was taking place, rather than curtail the observation without observing the end-point.

Table 5.4: Number of observed periods of problem solving during the main ten month study period

Location	Name of Child	Number of problem solving episodes
Nursery A	Paul	5
	Bea	17
	Cassie (Withdrew from study August 2010)	14
	Jack (Transferred to pre-school room August 2010)	27
Nursery B	Paddy	5
	Rosie	8
	Jossie	24
	Sam (Transferred to the primary school nursery class May 2010)	24
Nursery C	George	19
	Flo	21

Commentary: Table 5.4: Number of observed periods of problem solving
The highest number of problem solving episodes was observed during the self-initiated play of the three oldest children, Sam, Jossie and Jack, all over two years. This may reflect the link, which has already been made (Lambert, 2000), between self-initiated play and opportunities for problem solving, but it also reflects the relative ease with which these children's activities fitted into my analysis framework, for the reasons given below.

The older children, who were all over two years (Sam, Jossie and Jack), were offered more opportunity for self-initiated play (Hutt *et al*, 1989) in their nursery routine and played for longer periods than the children under the age of two years. There appeared to be a correlation between self-initiated play and opportunities for problem solving, already evidenced by Lambert (2000). However, it may also be that the beginnings and ends of problem solving episodes were easier to identify and that the periods of problem solving themselves were of a longer duration.

Occasionally, George's parents switched his days of attendance, to fit in with their work patterns. This meant that George was present at five of the ten observation sessions, which included the last consecutive four months of the main study.

With the exception of Flo, fewer observations were made on the younger children under two years. This was in part because their care routines offered fewer opportunities for play and in part because some of them were absent from nursery during the ten-month research period. In the month of August a bout of chicken pox resulted in short absences of three of the children (Paul, Cassie and Paddy) and a longer absence for Rosie who suffered health complications leading to a short period of hospitalisation. Paul (a relatively new starter to the nursery) also suffered frequent ear infections and colds that sometimes prevented him from attending the nursery. For one child, Paddy, his preferred sleep pattern was in the morning so that he was often asleep during observations

periods. Flo was present at every observation session throughout the ten-month period, which may account for the relatively high number of problem solving episodes recorded on her.

Bea, Rosie and Flo all arrived at their nurseries relatively late in the mornings (from 10.00 onwards) and preferred late morning and late afternoon naps. All were alert during morning sessions, Bea and Rosie being relatively settled into the nursery routine.

Flo (another relatively new starter to the nursery) became mobile before Rosie and Bea and immediately started to explore her nursery surroundings. Many of the observations of Flo are possible examples of exploratory play (Hutt *et al*, 1989) that overlap with possible instances of problem solving. As previously noted, Caruso (1990) states that exploratory play takes place when children are finding out about objects but are doing so 'with intent' (Bruner, 1990). The overlap between exploratory play and problem solving is discussed later in the chapter with reference to Flo. Her increasing mobility also appeared to give her more opportunities for problem solving of the kind usually associated with walking around objects when moving across a room. This is also discussed at a later point in the chapter with reference to attitudes to children taking risks.

Observations of all the children's problem solving appeared to show them working with purpose and creativity, utilising and manipulating materials in different ways. However, what was most striking in the observations made of the three older children was the evidence of their use of the sequence of 'plan, do and review' (Muir *et al*, 2008), a feature of problem solving discussed in chapter four and discussed later with reference to Jack and his approaches to problem solving when involved in block play.

Social problem solving

Although I recognise that a small number of the observations of the older children, Sam, Jossie, Jack and George, recorded their involvement in

what Broadhead (2001) in the case of older pre-school children describes as 'social problem solving', the majority concerned problem solving episodes featuring objects within their immediate physical environment, which Gifford (2010) classified as 'action problems' (p. 167). This was a reminder of the diversity of problems that the children encountered.

The diversity of problems

These 'action problems' arose when children were faced with physical challenges, such as how to reach toys, move over or around obstacles, transport objects, construct and deconstruct materials that fitted together. Some problem solving episodes arising from children's involvement in adult-directed play appeared to fit comfortably into what Gifford (2010) describes as:

- Believable problems, hypothetical or story problems
- Curious problems which 'intrigue' (p. 166)

The former types of problem seem to be present in adult-directed role play and story telling activities. Curious problems which 'intrigue', as Gifford (2010) writes, refers to those activities which practitioners plan, knowing that they are 'likely to hook young children's interests' (p. 167). These problems were often presented by the use of treasure baskets and of equipment such as buckets, spades and water wheels to prompt children's problem solving.

Some problems noted in my observations resulting from adult-directed play/activities could be classified as 'educational' problems, which Gifford (2010) describes as having the potential to make an important point. Educational problems tended to be focused on the introduction or consolidation of a mathematical concept such as shape, space or measure, which Lambert (2000), as previously acknowledged in chapter one, describes as 'school based problems' (p. 33). However, some observation of adult-directed play/activities (that daily planning sheets indicated as problem solving activities) offered what Gifford (2010) terms 'dubious problems or exercises' (p. 167). These offered children no choice or

control in the selection of approaches or outcomes and, as Gifford (2010) highlights, 'are not problems at all' (p. 167).

Problem solving and children under two

The earliest possible episode of problem solving was recorded on Paul at six months. In reviewing an observation of Paul with the help of Martha, his key person, it appeared that in repeatedly reaching for a toy Paul had a definite goal, acquisition, and that he was using persistent attempts in order to achieve this, including what Underdown (2002) describes as 'sending out messages for help' (p. 36) – sustained gaze and vocalisation - to which Martha in turn responded.

Martha agreed with my tentative view that Paul's actions amounted to problem solving rather than exploratory play, because he demonstrated aspects of 'plan do and review', in that he repeated an activity when unsuccessful (Willatts, 1997), and persisted (Claxton and Carr, 2004) and demonstrated 'planfulness', a term that Lambert (2000) uses to describe being purposeful and deliberate.

In the light of this observation on Paul, I conclude that the relatively low numbers of problem solving episodes I recorded on children under two may be attributed to my use of the framework to isolate periods of problem solving. Within the process of 'plan, do and review', which I associated with the process of problem solving, the 'review' element appeared to be missing in the early observations of the activities of children under two. However, if the sequence of 'plan, do and review' is seen in terms of 'patterns of decisions' (Bruner *et al*, 1956) then more possible problem solving episodes in my observations of children under two emerge. This is discussed with reference to Paul later in this chapter.

The limitation of my use of sustained shared thinking as an analytical framework

The limitation of my use of sustained shared thinking (Siraj-Blatchford *et al*, 2002) as an analytical framework was that it focused on strategic problem solving. However, the lack of strategy use by children under two,

Willatts (1990) argues, does not always result in trial and error being adopted; nor does it necessarily mean that problem solving is not taking place. As Willatts (1990) argues, trial and error is not as random as it first appears to be; in fact, it 'inevitably' involves choices and decisions.

Willatts (1990) concedes there is 'little doubt' that a two-year-old is a more frequent and effective problem solver than a one-year-old. As Willatts (1990) points out, a mobile two-year-old lives in a more complex world that requires more complicated strategies to manage and adapt to the challenges it presents. However, what is clear from my observations is that each of the ten children involved in my study all solved problems in different ways and the older the child, the easier it is to see them 'at work' problem solving. This is not to doubt the capabilities of the younger children in their attempts to make sense of their world.

Siegler and Alibali (2005) use the metaphor 'bricoleur' ('tinkerer') to describe children's approaches to problem solving, using any materials to hand to solve whatever problem arises. This may be a combination of innate abilities, content knowledge, reasoning, conceptual understanding, strategy use, the knowledge and support of other people and any other available capability or resource. As Siegler and Alibali (2005) note, children's solutions 'may not always be elegant, but they usually find a way to get a job done' (p. 342). This is illustrated in the next section, which highlights the different ways in which the children solved problems, the caveat here being that problem solving, which is unnoticed by adults, is probably also taking place.

A discussion of the main ways children used to solve problems that emerged from my observations

The ten children in my study approached problems in the following ways, which can be grouped under Siegler's (2005) classification of problem solving skills and linked to existing research findings:

- **Manipulation of materials** – including dismantling, adjusting one part, vertical movements and rotation (Bruner, 1973)

- **Marshalling assistance from others** – not necessarily their key person - by gazing, gesture, crying, loud babbling smiling, pointing, standing next to adult (Trevarthen, 1975), and using words requesting help, relying on adult interpretation of these words (Jordan, 2009)

- **Use of tools** – (Chen *et al*, 2000) such as spades, buckets, scissors, string (Arnold, 2003) and brute force (Gifford, 2010)

- **Making connections** – with enveloping/containing, dynamic vertical and rotational schemas (Athey, 2007) as well as recognising cause and effect and links with mathematical concepts such as shape, space and measures (Nutbrown, 2006)

Manipulation of materials

Bourgeoise, Khawar, Ashely-Neal and Lockman (2005) document that over the course of the first year, children acquire 'a rich and varied repertoire' (p. 233) for manipulating objects. This includes:

- Mouthing – exploring objects with their mouth
- Simple manipulation – random grasping, leads to visually guided action

Keen (2011) adds to this list of skills visually guided manipulation that elicits preparatory adjustment of handgrips and hand orientation. Keen (2011) goes on to evidence that as infants mature they become more selective in their use of actions, tailoring a particular kind of movement to an object's unique physical properties so that by the middle of their second half-year:

> Infants finger textured objects more than non-textured ones, shake or bang sounding objects more than non-sounding ones and press pliable objects more than non-pliable ones. (p. 233)

Although previous research suggested that these actions are arbitrary and stem from 'cognitive gaps' (Belsky and Most, 1981), the more recent evidence of Keen (2011) and Bourgeoise *et al* (2005) considers object manipulation in a different light. Keen's (2011) view is that children's manipulation of objects provides them with information about the objects' properties that they can then exploit in subsequent problem solving. Drawing on the studies of Brown (1987), Keen (2001) argues that the knowledge that very young children gain from manipulation of objects provides them with 'deep structural principles about physical properties'

(Brown, 1987 p. 58) which can be transferred to other situations, including problem solving.

What the ten children involved in my study appear to be displaying in their manipulation of objects during problem solving episodes is an ability to bring together perception, motor coordination and cognition to form what Keen (2011) describes as a 'rich stew' of problem solving skills (p. 3). This indicates an ability to carry out a planned action based on an understanding of causal events and relationships. This sequence, Willatts (1990) sees as a crucial part of the problem solving process which the scenarios contained in the later section - children at work solving problems – illustrate, alongside another capability, the children's ability to marshal assistance from others.

Marshalling assistance from others

Examples of the children marshalling assistance from others recorded in the main observations show that each child employed a different mode of communication. Here, it was striking that children over two and occasionally children under two in their nursery settings sought help both from their key person and from familiar (other practitioners working in the nursery) and unfamiliar adults (including myself as a researcher).

Children's methods of communication, which all feature in Karmiloff-Smith's (2005) study of children under three included:

- Gazing
- Crying
- Loud babbling
- Gesture
- Smiling
- Pointing
- Standing next to adults
- Using words requesting help

Children's ability to make their wishes known depends, of course, on the ability of adults to understand (Jordan, 2009: Lancaster and Broadbent, 2003). In the context of my study this communication, my observations indicate, happens very quickly. It may be, as Gopnik *et al* (1999) point out, that babies are pre-programmed to make their wishes known to their carers. However, it may also be that the children's key person is 'very good' at translating the children's signals, which Lancaster and Broadbent (2003) and Selleck and Elfer (1977) see as a part of 'tuning in to' children.

As previously noted, children also sought help from familiar and unfamiliar adults in their nurseries. For some children, such as George, his older friend and companion Thomas proved to be a frequent source of help, illustrating what Trevarthen (2003) terms the 'receptive sociability' of infants (p. 224) and their ability to form friendships. Certainly, Thomas appeared to be George's best friend and confidant as well as a knowledgeable other (Vygotsky, 1978) in his role as a 'demonstrator' in how to use a range of tools to solve problems.

Use of tools

Tools used by the children in my observations included:

- Readily available objects that have a specific purpose e.g. buckets, spades and scissors – although access to scissors was restricted
- Self-created tools e.g. string, role play resources such as handbags
- Symbolic tools e.g. pictures and instructions

In their use of tools, older children during observation periods appeared to use them in a planned way by, for example, using a bucket as the easiest means of moving sand from the sandpit to the water tray. However, with the exception of the use of scissors, which often required coordination and strength, it appeared from a review of my observations that once the use of tools such as buckets and spades had been modelled, their use was readily applied to other problems. This reflected the research findings of Chen *et al* (1997) involving a group of children in the ten to thirteen month age band who were able to transfer their knowledge of tool use to

other problems even though the solution to the new problems appeared on the surface to be rather different.

Materials such as string and role play resources such as handbags, scarves and miniature plastic home corner cutlery were all adapted for use as tools to prise objects apart and to transport them. String and skipping ropes for the older boys, in particular, were often used in their efforts to move heavy objects such as trikes stuck in doorways – a method that practitioners were fairly sure they had not introduced or demonstrated.

Three observations featuring symbolic representation of tools involved older children, Sam and Jossie, being introduced to pictures to help them put together a large floor jigsaw puzzle, and a series of diagrams with written instructions which their key person read out to help them construct a large marble run using connecting pieces and tubes. These were both adult-directed activities in which the benefits of using pictures and diagrams as an aid to problem solving were demonstrated.

The last and most frequently used tool by both adults and children was brute force. Observations show that this was often the first method employed, by both children and adults, to solve a problem involving the manipulation of objects, as well frequently being a last resort. When older children, particularly boys, used brute force, observations record that practitioners always discouraged it and suggested an alternative method. Reasons given for this discouragement seemed to rest on likely damage to resources and potential harm to the child. However, practitioners themselves used brute force as a solution to problems and being 'strong' was seen as a praiseworthy attribute. So, although brute force was one of the main ways children used to solve problems, and one used by practitioners it seemed to be both accepted and discouraged, thus offering mixed messages to the children.

Making connections

As previously documented, Piaget (1953) linked forms of thought to cognitive structures resulting in children working out and following patterns in their internalized thought and actions. As acknowledged in chapter two, Piaget's (1953) description of this as 'schematic' is open to interpretation. However, the work of Athey (2007) and others (Atherton, (forthcoming), Nutbrown, 1994; 2006; Meade and Cubey; 2008) has illustrated the power of schematic thought in young children's learning. As Nutbrown (2006) writes:

> Acceptance of the view that young children can and do learn as they pursue particular patterns of behaviour and interests requires a further step. That is consideration of how such patterns (or schemas) might form part of the foundation of children's growing knowledge and understanding. (p. 59)

As outlined in chapter two, I have an interest in young children's schemas, which potentially creates a bias in my evaluation of young children's problem solving. However, many children did appear to be utilizing their preferred patterns of thinking as a means of problem solving. These patterns, as discussed later, for some children could be linked to categories of schema identified by Athey (2007). For example, a child showing interest in a vertical dynamic schema (Athey, 2007, p.116) used up and down movements when attempting to remove a screw-top lid from a container even when previously being shown by his key person that to rotate the lid would be a more successful approach. Other observations, such as numbers 139 and 140 below, recorded the action of Jack who appeared to be helped by his key person to solve problems using ways within his preferred and constant pattern of thinking.

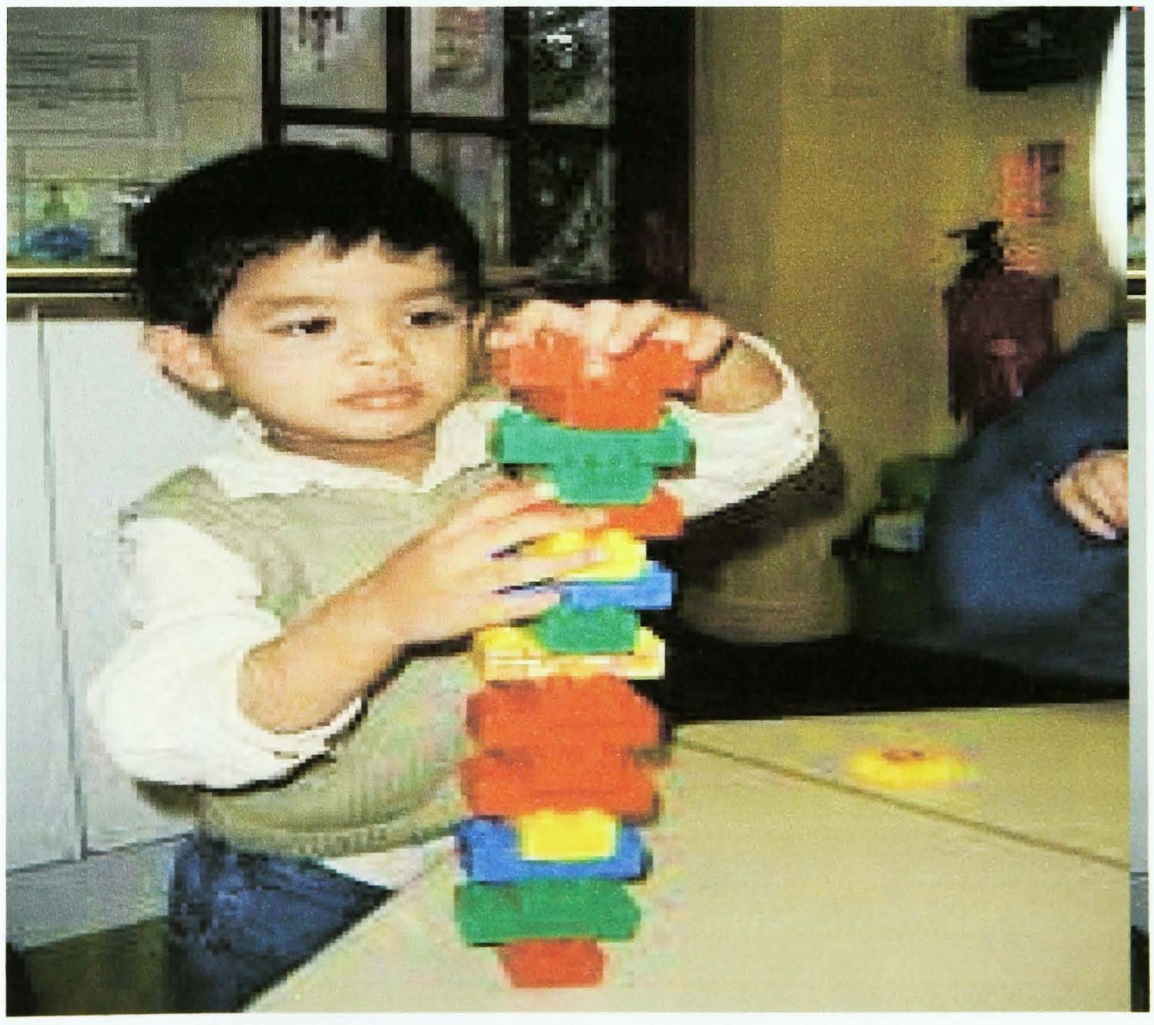
Box 5.1: Observation 139: Jack building wooden towers solving problems within his consistent and preferred patterns of learning

ref Ob.139/J Aug 2010	Observation number 139 Abbreviations: Jack (J) aged 2 yrs 9 months Kim (K)- researcher Problem to solve – How to build a tower	Coding Problem Elements of problem solving (p/s)

	and stop it from collapsing	Children's main p/s ways KP support Sweeper category
Timings	I sit down next to the outdoor brick area and start to watch J, who has completed a tower using four wooden bricks.	
10.00	Observation starts 10.00	
	J chooses three smaller rectangular wooden bricks and places them near the tower – another three minute period is spent standing back and looking at his tower	Plan Do Review
10.07	Two boys approach J's tower and J stands in front of it spread-eagling his legs and arms (protecting the tower/discouraging others from joining into his play?). Both boys move away and find two abandoned trikes.	
10.08	J turns and looks at his tower, before reaching down for one of the smaller wooden bricks	
10.10	J stands on a wooden brick and places the smaller wooden brick on top of his tower – jumping down from the brick, J's routine of looking (surveying?) continues.	Engagement & purpose
10.12	J uses two smaller wooden bricks to build second small tower followed by two larger wooden bricks and four smaller bricks – these structures collapse.	
10.18	J – 'Ich (It's?) bic (big?) yer know, yer know', establishes eye contact with me J - 'Bic, bic, bic' (moving his arms up and down to emphasise the height of the tower?)	Review
10.20	J drags across another wooden brick making huffing and puffing noises (to attract my attention?) – he stands back and looks at his tower (surveying?)	Continuation of schema? – x ref ob 134/j, 14/J Research journal notes 123 – 154J
10.22	J uses two smaller wooden bricks as a foundation to build second small tower followed by two larger wooden bricks – this structure collapses	

10.25	J makes eye contact with me J builds another tower with four smaller bricks as a foundation, one on top of each other at the bottom followed by a larger brick I draw J's attention to the smaller bricks by sitting next to the tower of bricks, talking to J and pointing to the small bricks - I turn the tower upside down so that the larger brick is at the bottom – J walks away	Seeking help? Indication of schema? Review Problem J's disengagement
10.31	Observation ends 10.31 Jack resumes his interest in towers ten minutes later indoors. As observation 140 records Jack receives support in his problem solving from Lindy, his key person.	

Photograph 5.1: Jack building a Lego brick tower



Box 5.2: Observation 140: Jack building wooden towers solving problems within his consistent and preferred patterns of learning

Ob.140/J Aug 2010	Observation number 140 Abbreviations: Jack (J) Lindy (L)- Key Person (J) aged 2 years 9 months Possible problem – how to build a tower and stop it from collapsing	Coding Problem Elements of p/solving Children's main p/s ways KP support Sweeper category
Timings	I enter the room and greet J who is sitting at a table (See Photograph 5:1)	
10.41	Observation starts 10.41 J is using 18 large and small Lego bricks on the table next to the outside door. He is making a tower, using a repeated pattern consisting of alternating small and large Lego bricks but appears to be unable to make it stand up (perhaps because he had first used a much smaller brick at the bottom of the tower)	Problem x ref ob 139
10.45	L joins J she admires his tower and makes an up and down movement with her hand – 'It's going up and up'	Praise/linking in to schema
10.48	J grins at L L builds two towers using the same size Lego brick. She holds J's tower upright and places it between her two towers. L points to the gap left at the bottom of J's original tower and tells him – 'That's the problem'	Support – linking into schema x ref Research journal notes 123 – 154J
10.53	J builds a new tower using ten Lego bricks of the same size and places it next to L's towers	Review
11.00	J dismantles his original tower and re-designs it using the same size bricks	Review
11.12	Three more towers are constructed by J – all the same design and using the same number and size of bricks	Engagement & purpose

11.20	L draws J's attention to the height of the towers – using her hands in an up and down movement – using words such as 'all the same', 'like each other', 'standing tall all by themselves'	Promotion of schema? – x ref ob 134/j, 14/J Research journal notes 123 – 154J
11.45	J disengages from task then moves back to the garden area, leaving L indoors chatting to another child who has joined the activity	
11.58	J creates a tower of seven wooden bricks all the same size which does not collapse – he continues to build three more towers of the same design J leaves the towers in place when asked by L to wash his hands for snack	Engagement & purpose
12.20	Observation ends 12.20 <u>Discussion with Lindy</u> When I discussed observation 140 with Lindy, she agreed that Jack might have walked away from the first activity, as I was an unfamiliar adult. However, she went on to add that Jack was 'really into up and down' and this had guided her support of him. Lindy on reading observation 139 thought that I had offered Jack a solution that was based on rotation – turning the tower upside down so the larger bricks are at the bottom. Lindy stated that this was a 'good idea' but not one that Jack was interested in, suggesting that my solution did not take account of his current patterns of thinking.	x ref Field note 123

Lindy, Jack's key person, appeared to be guided by his interest in the concept of 'up and down'. This guided support appeared to extend Jack's involvement in a task as he constructed three more towers, all of the same design and using the same number and size of bricks.

In highlighting the role of Jack's possible schema I am not losing sight of the interconnectedness of approaches that children use in their problem

solving. As Siegler (2005) concludes:

> Learning tends to follow irregular paths involving regressions as well as progress, short-lived transitional approaches, inconsistent patterns of generalization and other complexities. (p. 770)

This is an important message nevertheless; during the pilot and main study some children did appear to draw on their current schemas, confirmed by their key person, as a means of solving problems. Additionally, in doing so some children appeared to make connections that had mathematical roots.

Research such as that of Baroody, Li and Lai (2008) show that very young children 'can do mathematics' (p. 30) while Evangelou *et al* (2009) documents that children in their first year of life are sensitive to mathematical concepts. For example, they can recognise 'how many' without counting, and distinguish the difference between sets of one, two and three objects. Additionally Dolan (1998), drawing on a range of research findings, argues that awareness of height, capacity, weight, size, recognition of shapes, and the ability to manipulate shapes are present and 'in full working order by the end of the second year of life' (p. 20).

Evangelou *et al* (2005) acknowledge that 'logico-mathematical knowledge' (p. 43) is used by young children in their problem solving, which is confirmed in research findings involving children under three (Steri, 2005). Many researchers such as Nunes and Bryant (1996) have argued that there is a need to help children utilise their everyday understanding of mathematics so that mathematical learning is less than a transmission of facts and more, as Lave and Wenger (1991) urge, 'situated practice' (p.51). Using problem solving as a vehicle to promote young children's mathematical development is well acknowledged (Williams, 2008). However, as Steri (2005) points out in regard to children under three, the use of early mathematical understanding may become merged with random thoughts and actions, making it difficult to distinguish one from the other.

During analysis I classified some of the children's approaches to problem solving as 'trial and error'. However, the repetition of their action, persistence and occasional frustration perhaps would have been better described as 'inconsistent patterns of generalization and other complexities' (Siegler, 2005 p.70). My observations show that children showed frustration in their problem solving and as the next section documents, dealing with children's frustration appeared to be an important element which was taken into account by the way in which practitioners supported children's problem solving.

How did the children's key person support them during problem solving episodes?

Frequently observed methods of support

My observations indicate that the most frequent ways demonstrated by the children's key person in supporting their episodes of problem solving were:

- Taking over the problem and providing a solution - this often took place to defuse children's frustrations
- Modelling a solution – through their physical actions accompanied by language
- Synchronised actions – working alongside
- Providing verbal instructions
- Chunking problems into stages
- Providing emotional support that says 'it's ok to problem solve'
- Providing emotional support in form of cuddles, cues and consistent nearness

These forms of support appeared to be outside the sustained shared thinking framework although they did contain its three principles of – communication, collaboration and creativity (Siraj-Blatchford, 2007). Consequently, during analysis they fell into what Wellington and Szcerbinski (2007) describe as a 'sweeper (miscellaneous) category' (p. 107).

Taking over a problem and providing a solution

Adults 'taking over' the children's problems and providing a solution appeared to be the most frequent method of support offered. Partly, it diffused children's frustrations and partly it was in response to the practitioners' intuitive feeling that the problem was too demanding for the child and might result in failure. However, the frequency of this method of support appears to indicate practitioners' desire to protect children from failure and keep them happy. Rogoff (2003) notes that controlling frustration was a dominant feature in mother/child interactions during joint problem solving activities, which Rogoff (1990) terms 'automaticity' of support (p. 100).

Controlling children's frustration, Rogoff (1990) links it to parenthood - 'it's what parents do' (p. 101). It appears from my observations that it is also what early years practitioners do. To what extent frustration motivates problem solving is unclear but frustration and failure do occur. To what degree very young children are supported in their acceptance of frustration and failure remains an unresolved question. However, alleviating children's frustration does appear to be an important factor which practitioners take into consideration in their support of children's problem solving. The key person's desire to see the child find a successful solution was striking. Often to do this practitioners modelled a solution.

Practitioners modelling a solution – through their physical actions accompanied by language

Modelling solutions for children took the form of one-to-one guidance. Children often sat between the practitioner's legs, so that modelling occurred in front of them with the practitioner sitting behind them and providing a running commentary, in which the practitioner described actions and affirmed the success of the solution. For children under one year, it appeared to be common practice in all three nurseries for practitioners to hold the children's hands to help grasp an object or guide an action, for example when faced with the challenge of using a spoon at mealtimes. Again, this support was accompanied by a running commentary and encouraging or congratulatory words.

Synchronised actions – working alongside

Synchronised actions - working alongside and mirroring the children's actions - was recorded in three observations involving children under one. Here, the children's key person replicated the actions of the child, which some practitioners stated enabled them to follow children's patterns of enquiry and to experience problems as encountered by a child, albeit on a different level, for example the adult grip being stronger than the infant's. As a result, when the children found a solution the practitioners had an insight into how it was reached and were able to use this to gauge at what point intervention would be beneficial. Observation 88 is offered as an example of synchronised action as a method of adult (key person) support.

Box 5.3: Observation 88: Example of synchronised action as a method of key person support

Ref	Observation number 88	Coding
Ob.88/R July 2010	Key Person support by synchronised action.	Problem Elements of p/solving Children's main p/s ways KP support Sweeper category
	Abbreviations: Rosie (R) - aged one year Tina (T) - Key Person Kim (K) - Researcher	
	Problem: Transfer food from cereal bowl to mouth using a spoon	
	I enter the room and greet T. She points to R, who is sitting in a high chair - T is sitting on a stool facing her	
Timings		
9.30	Observation starts 9.30	
	Both T and R are holding spoons in their left hands. R moves her spoon between her bowl of cereal and milk and her mouth but despite moving her head she repeatedly fails to feed herself, and most of the cereal drops into her pelican bib. T mirrors R's action using the same spoon and bowl of cereal on the highchair tray to feed herself and models to R how to place the spoon into her mouth – by turning her wrist just before reaching her mouth.	Problem Support x ref Research journal notes 44 - 46

	T – 'We are having a go' - smiling at R 'Looks who's here she's come to see how clever you are' T adds, 'It's great to have R back in nursery after her chicken pox but R is still very tired.' T continues to mirror R's actions …... <u>Discussion</u> T – 'I'm trying to work out what's not right – I thought the spoon was too small but look she can grip it, she's worked that out but needs to get the idea of turning her wrist – can you see that? – she's worked out that she can dribble food into her mouth by her fingers from her bib – she worked that out a long time ago - it's the wrist turning that's not here really, so it's time to move her on – it's the wrist turning that not here really so giving her lots of things to work out - turning things might help or not really as she may not be ready physically to turn her wrist – not sure – R likes moving things up and down but not around and around – I saw this when she was playing with the ribbon basket'. When I asked if mirroring the children's actions was something that T usually did, T replied: 'Yes - often – it helps me see it from their way – is it right? – I just do it – it helps'.	Support of schema x ref research journal notes 123 x ref Field note 48
9.41	Observation ends.	

Observation 88 appeared to demonstrate that Tina knew of Rosie's fascination with moving objects up and down - the beginnings of a possible vertical dynamic schema (Athey, 2007) - and questioned whether Rosie's inability to rotate her wrist was developmental or a result of a lack of interest in all things rotational. To help Rosie progress with the problems she had with using a spoon to feed herself, Tina proposed to offer her toys that required her to turn her wrists but seemed prepared to

acknowledge that Rosie might not be 'schematically' interested in these activities. I would argue that the support offered to Rosie was relevant to her, taking account of her possible schematic thinking by a practitioner who knows her well.

Providing verbal instructions

Verbal instructions vary from informal remarks to sequenced instructions, including:

- Telling the child to wait for help
- Encouragement to try another way
- Congratulations and praise
- Let's wait and see
- Step-by-step instructions

These remarks appeared both to instruct and reassure children, although for some older children the request to wait for help was often ignored as the impulse to carry on regardless took over. Encouragement to try another way and praising children's efforts occasionally produced what Claxton and Carr (2004) describe as the 'undermining effect' (p. 92). In this, Claxton and Carr (2004) maintain that in some circumstances direct praise weakens rather than strengthens the resolve to persist with a task perceived to be difficult.

More formal remarks consisted of sequences of instruction, taking the child step by step through possible solutions. Often these were accompanied by gestures and formed a running commentary. Sometimes, when older children were part of a group involved in adult-led play or activities, such as completing a jigsaw, instructions were unaccompanied by gestures but intonation (particularly exaggeration) indicated the importance of such statements over others.

In the context of sustained shared thinking (Siraj-Blatchford *et al*, 2002), one area of support that was not used was that of verbal feedback. Supporting children over three in the review of their own learning is

widely acknowledged to be beneficial (Sylva *et al*, 2004; Weikart *et al*, 1978). Additionally, research into the understanding of concepts such as balance (Siegler and Chen, 2002) indicates that two-year-olds do benefit from verbal adult feedback. However, my observations suggest that feedback does not appear to have permeated into the baby and toddler rooms of the four nurseries involved in my study.

Supporting children under three to review their own learning and providing adult feedback was discussed with the three nursery managers. The consensus was that there were:

- Uncertainties about what form feedback should take with children under three – what did it look like?

- Uncertainties about the best age to introduce feedback - and perhaps whether if it was more appropriate to pre-school children

- Concerns that children would be unable to sustain interest and concentration during verbal feedback

- Lack of time to deliver feedback with children under one, as priority needed to be with meeting the children's physical care needs

Recapping was another strategy that appeared to be seldom used, as was prompting children to remember past events or modelling actions from previous activities. The rationale behind this was unclear but may have been linked to the practitioners' view of children's immaturity and that as infants their relatively short lives contained few memories that they could retrieve.

It may be that recapping, recall or review is simply not a well-established method of supporting children under three, the emphasis being on support of the 'here and now' (Willatts, 1997) This, combined with the perceived egocentricity of very young children (Willatts, 1990), perhaps reinforces this. As a result, supplying children under three with new experiences displaces the review of old ones. Epstein (2003) also points out that adults often resort to the use of questioning to promote recapping, recall or review, which being linguistically based they see as being more appropriate for use with older children. In my observations the children's

review of their learning and providing feedback seemed to be an underused element of adult support in comparison to other forms, such as chunking problems into stages.

Chunking problems into stages

Chunking problems into stages involved both verbal instruction and physical modelling on the part of the children's key person and other practitioners in the team. The rationale behind dismantling problems appeared to reflect the beliefs that children learn best in stages and that simplifying a problem by presenting it in easily manageable stages increased the likelihood of success.

Although chunking problems into stages appeared to be an effective method of support with the oldest child, Sam, particularly when faced with convergent problems, the unpredictability of younger children, which David (2003) sees in terms of children following their own agendas, often resulted in children following unplanned directions. So what started out as chunking one problem into stages developed into a series of new problems.

Providing emotional support

This was a key support mechanism for all the children in the study. It appeared to take two forms: encouraging children to problem solve and support them once they had started. Campos *et al* (2004), drawing on the concept of 'social referencing', suggest that infants explicitly look toward their primary carers for clues as to how to respond socially and emotionally to the events that they encounter. Rogoff (1990) view this social referencing as 'building bridges' in which adults guide children by:

> Providing emotional cues about the nature of the situation, nonverbal models about how to behave, verbal and nonverbal interpretations of behaviour and events and verbal labels that classify objects and events. (p. 66)

The presence of this emotional support, Elfer *et al* (2003) see as an element of the key person/child relationship. Whitebread (2007) in his

study of pre-school children's independent learning also observed that the presence of emotional support resulted in children 'feeling in control' (p. 171). This Whitebread (2010) later argues sustains perseverance in problem solving. Whitebread (2010) goes on to add that often in the absence of emotional support:

> Either the element of perseverance is lost as adults complete the task for the children, or pleasure is replaced by frustration and the task is abandoned. (p. 165)

Evangelou *et al* (2009) document the importance of the emotional climate on young children's learning. During my main study I noted some aspects of emotional support that reflected the importance that Goldschmeid and Jackson (2004) give to the close proximity of an early years practitioner to the children in their care. In my research journal I describe this proximity as 'the 3C's – cuddles, cues and consistent nearness' (research journal August, 2010) which appeared to give 'the green light to problem solving – it's ok to problem solve' (research journal, August, 2010).

For older children, cuddles often took the form of hugs and 'high fives' and, as for younger children, appeared to offer the reassurance that everything was 'going well'. Cuddles were also offered in response to frustration and as an encouragement to 'try again'. Emotional cues took the form of exaggerated facial expressions - wide eyes, crinkling of noses, directional gazing and sympathetic noises and words which sustained children's efforts by either giving approval or occasionally offering nonverbal clues. The consistent nearness of the key person and other members of the team to the key children appeared to create a sense of trust, which Elfer *et al* (2003) see as evolving from the child/key person relationship. Many of the older children requested help in their problem solving from their key person or familiar adult in their nurseries and appeared to 'know' that help would be given.

For some of the younger children, my observations show that the 'nearness' was physical - sitting next to or in front of their key person,

being supported in their key person's arms or between her legs when sitting on the floor. This appeared to offer them 'sanctuary' in which to retreat when problems became overwhelming. It also seemed to offer them a base from which to reach out from knowing that retreat was possible. For older children and mobile children, the importance of being able to access physical comfort did appear to be important, particularly when an approach to a problem resulted in frustration. My observations indicated in agreement with the conclusion of Nutbrown and Page (2008) that babies and young children need:

> Adults who know about children's needs, know about children's minds, understand different theories of learning, understand emotional literacy as well as literacy and numeracy: and are highly developed in their skills and attitudes which support the healthy and holistic development of children's minds, bodies and souls. (p. 179)

This poses challenges for early years practitioners, particularly in the light of the children's individual characteristics and varying needs. During the main study period what was so absorbing was the uniqueness of each child's approaches to problem solving and the different ways this was supported. To capture the children 'at work' solving problems, the next section is organised to illustrate the problem solving capabilities of each of the ten children. To highlight the differences in their problem solving, each of the ten children are introduced and examples of them 'at work' problem solving are provided.

Each section is followed by an overview of the support offered by their key person. This leads to a discussion of issues that arise from the field observations which impact on acknowledging and supporting very young children as problem solvers.

> We have only to watch his play with a discerning eye, and listen to is comment and questions, in order to realise how his mind is beset with problems of one sort or another – problems of skills, problems of seeing and understanding. Problems of feeling and behaviour … He is always in his own mind. Concerned with watching and trying to understand and deal with things and people, the objects of the world outside him, which he so much needs to master and to comprehend. (Isaacs, 1954, p. 9)

Children 'at work' solving problems

Sam

Sam – aged 2 years 8 months

Sam is a successful problem solver. Most of his problem solving appears to arise from his self-initiated play and involves manoeuvring bikes and dismantling toys and putting them back together. Sam seems able to transfer the skills that he uses in his play to adult-led activities, particularly completing forty-piece floor jigsaws that involve the same dismantling and reconstruction skills that Sam uses in his self-initiated play. Sam appears to display 'planning, do and review' in his problem solving as illustrated by observation 10. He also appears to be using private speech (Vygotsky, 1986) to accompany his actions (Observation 10).

Box 5.4: Observation 10: Example of Sam 2 years 8 months using plan, do and review in his problem solving

Ref Ob.10/S February 2010	Observation number 10 Abbreviations: Sam (S) aged 2 yrs 8 months Caroline (C) key person Problem: How best to cut paper I am sitting in the corner of the pre-school room. S is sitting at a table with four other children. All are taking part in an adult-led activity.	Coding Problem Elements of p/solving Children's main p/s ways KP support Sweeper category
Timings 9.25	Observation starts 9.25. C asks S to glue triangular and square shapes into a given traced template of a house to represent bricks and a roof. Although the resources are provided for S. He leaves his seat to fetch a number of square shapes from a nearby shelf. As he does so he utters 'Tem, tem, tem', which accompanies each of his actions	Plan Use of private speech x ref research journal notes 20 -39

9.29	S returns to his seat and lines nine paper squares in front of the paper template. Using his right hand he reaches for the glue pot and pours a layer of glue on to the template S appears to lay each paper square randomly on to the template	Do
9.35	S picks up the template and holding it at his eye level looks at it – as he does so he utters 'Nah, nah, nah'	Review
9.40	S then reaches for a pair of plastic scissors and tries to cut the overhanging paper on the left side of the template. Failing to do this he places the template on the table with the scissors on top and walks away.	
9.43	Observation ends 9.43, resumes 10.12	
10.12	C asks S to return to the table and finish his house – he leaves the snack table and sits next to C	
10.16	S holds his template at eye level, 'Cut, cut, cut'. He points to the left edge of template	Asking for help?
10.18	C hands S the plastic scissors. She is sitting on his left and watching him. She says 'Cut around it Sam, yer'. C nods her head S - 'Nah, not right, nah'. S drops the plastic scissors on to the floor and leaves the table. Observation ends 10.18, resumes 11.00	Verbal instruction
11.00	C asks S to sit with her to finish his house. S sits down at the table. C is holding his template, which has now dried. S points to the adult scissors on the high shelf. C reaches for the adult scissors and cuts the overlapping paper while S watches	Ownership of problem
11.10	S leaves the table while C is still cutting the overlapping paper Observation ends 11.10	

Sam – aged three years two months

Observations made of Sam, as an older child did not contain private speech (Vygotsky, 1986), which Stanley (2011) describes as:

> A critical intermediate stage in the transition from external social communication to internal self-direction. (p. 13)

This may indicate a growing confidence in his problem solving within the nursery so that, as Diaz (1992) maintains, very little or no private speech is necessary. Sam's request for the big scissors to be used to help him cut around a shape suggests that he is familiar with this tool and its uses, He appears also happy to approach Caroline to help him achieve his goal.

Many observations taken during Sam's participation in my main study occurred during outdoor play sessions, usually involving manoeuvring a tricycle around objects, hiding them in the wooden play house and when involved in large brick construction play - again building walls to store 'his' tricycle. Sam's increasing manual dexterity resulted in him being able to take toys apart and assemble them, making minor adjustments to enable objects to slot into each other.

Sam appeared to be very familiar with how the resources in his base room were organised and could independently access tools, such as scissors and string, to help him tie his beloved tricycle to a post so no one else could use it. Observations record Sam working independently at solving problems in his self initiated play but also appearing confident in approaching adults, not just his key person, Caroline, to help him. Sam transferred to a nursery class at his local primary school in May 2010 and withdrew from the study.

In what ways did Sam's key person support his problem solving?

Observations indicate that Caroline was receptive to Sam's requests for help and would model skills such as cutting around a shape using adult scissors. Caroline stated that encouraging children's independence is high on her list of priorities and this she feels is reflected in the way resources such as toys and tools such as children's safety scissors, office equipment

(hole punch, paper clips, elastic bands string) and glue sticks are all made available to the children. In addition, Caroline ensures that recycled items such as empty boxes, yoghurt pots and egg boxes are all arranged in child-height storage units and shelves in the pre-school room. This arrangement, Caroline feels, enables children to select items to create models, pictures and use as tools, such as when Sam needed to cut a length of string as part of his solution to prevent other children from using the tricycle. Resources that Caroline feels are dangerous for children to use unsupervised, such as adult scissors, or are expensive, such as glitter, are kept on a high shelf out of children's reach - for adult use only.

Caroline stated that she introduced problem solving to Sam through activities such as jigsaws and counting games, as part of planned small group activities. Caroline had noted that Sam was a reluctant participant in these small group activities so she usually sat close to him, encouraging him with words and smiles to take part and offering 'well done stickers' immediately after he had successfully completed a given task.

Observations of Sam involved in adult led activities, such as completing a jigsaw, show him responding positively to adult praise. However, the motivation and high-level persistence often shown in his problem solving during his self-initiated play did not feature in his involvement in adult-led problem solving tasks. Similar accounts are to be found in the research study of Whitbread *et al* (2004) with children in the three-to-five-years age range in which:

> Given the opportunity to make their own choices and decisions, the children were remarkably focused and organised and pursued their own plans and agendas with persistence and sometimes over surprisingly long periods of time. (p. 41)

When matched against the suggested role of the adult in sustained shared thinking (Siraj-Blatchford *et al*, 2002), observations indicate that Caroline used suggestions to encourage further thinking that contain direct instructions as well as modelling possible solutions to problems.

Discussion of Sam's problem solving

Sam appears to have identified Caroline and other adults in the nursery as resources to help him reach his goals (for example those who could access tools, such as sharp scissors, which were 'right' for the purpose of cutting paper). He also demonstrated his ability to select appropriate materials such as string, from a collection of materials that are available for him to use. Sam also seems to have an understanding of the 'rules' that govern accessing materials and resources. For example, he demonstrates an understanding that some tools are 'out of bounds' unless you ask an adult's permission to use them but others can be independently used without prior adult permission. Sam's confidence in accessing materials and resources demonstrates a familiarity with his nursery surroundings. Sam appears to have worked out the social codes of behaviour, which govern how help from adults in his nursery is requested. This sets problem solving within the realms of social interaction that Rogoff (1990) describes as being negotiated and managed by adults, who set the ground rules that the children learn to follow. To move this interaction to one of social collaboration, Whitebread *et al* (2004) point out that the boundaries, rules and expectations need to be established and constantly re-negotiated by both adults and children. Earlier, Whitebread (1996) in his research on fostering independent learning in foundation stage classes observed that when collaboration with adults occurred children appeared to be more willing to engage with challenging problems. Later Whitebread *et al* (2004) extended these findings to add that during collaborative learning sessions, although the children were not always successful in finding a 'right' solution, they were offered a range of strategies and materials to experiment with.

Observations record Sam's impressive ability to plan and fine-tune his planning to meet the demands of the problems that he encounters in his self-initiated play. Here, he is using mathematical concepts, such as counting, cardinality, one-to-one correspondence, shape, space and measure that Gura (1992) witnessed in the block play of similar aged children. Sam's understanding of these concepts is being used to help him

fit objects into spaces and build walls to create boundaries to store his trike. However, it was unclear from observations and from discussion with Caroline, his key person, how far Sam was able to translate these encounters with mathematical concepts into mathematical language and symbols.

Steri (2005) highlights evidence to suggest that babies and young children use mathematics at an informal and practical level. However, other evidence suggests that some individuals experience difficulties in making connections between what Gura (1992) describes as 'active-as-you-go' (p. 97) and 'formal symbolism' (Williams, 2008, p. 47). Hutt *et al* (1989) conclude that this difficulty cannot be attributed solely to a breakdown in individual reasoning but in part to the quality of communication between children and more knowledgeable others. To this, Hughes *et al* (2007) add that a mismatch of home/school experiences may also hinder young children's mathematical development. That mathematical concepts are used in problem solving is acknowledged (Williams, 2008) but as Nunes and Byrant (1996) point out the degree to which they are developed within children's problem solving activities varies.

Although Caroline, Sam's key person, was aware of his ability to manipulate objects, build with bricks and manoeuvre trikes, she saw these skills in terms of physical development. She saw his eagerness to play and his persistence with tasks such as building a wall around 'his' trike as 'boyish behaviour' and not as the beginning of learning dispositions (Claxton and Carr, 2004).

Discussions with Caroline throughout the main study period confirmed that she was familiar with the concept of supporting children's learning through play. However, she made clear that she felt constrained by the expectations that she sensed from the local schools and that, as a result, she tried to prepare the children for tasks of the kind that she believed they would face in their first year of school. In her view, part of this preparation, in the areas of problem solving, reasoning and numeracy

(DCSF, 2008a), involved emphasising convergent rather than divergent problems, by introducing children to 'table top' activities such as jigsaws, number games, bead threading and sorting and classification of plastic shapes, all of which have a single correct solution or answer. Lambert (2000) argues that following a prescribed curriculum often devalues problems that arise spontaneously in children's everyday activities. Lambert (2000) writes:

> Figuring out how to use the stapler may be a better context for developing problem solving than ones set by adults. (p. 20)

The motivation and persistence that Sam displayed in his self-initiated problem solving appeared to be overlooked in his nursery assessment records. Here, success was seen as 'achieved', 'working towards' and 'not achieved', which Dweck and Leggett (1988) see as 'performance goals' (p. 257). These three statements are recorded in the children's assessment folders and passed on to the children's schools. In this light Sam was 'working towards' in his problem solving.

Although the EYFS (DCSF, 2008a) encourages practitioners to extend children's learning through play whilst valuing children's 'own graphic and practical explorations of Problem Solving, Reasoning and Numeracy' (p. 63), I am not certain whether the spontaneity of Sam's self-initiated problem solving would be aided or curbed by adult intervention. Would adult involvement mar the freedom and delight that Sam displays in organising his immediate world? Gura (1992) poses an interesting line of enquiry, questioning what becomes of children who seem to have a special flair for setting and posing questions as they go through the formal education system – does the special competence persist? Certainly, all the children in my study were successful problem solvers. Sometimes as with Jossie and Jack, it appeared to be recognised unreservedly by their key person.

Jossie

Jossie aged two years three months

At the beginning of the study much of Josie's problem solving appeared to be social, documenting her attempts to join in with the play of older children. Although as previously documented, my main focus was on children's problem solving with objects, it was clear that for Jossie her priority was to make friends.

Jossie gravitated towards role play areas (dressing up) where she could follow her passion for enveloping and containing objects – handbags were stuffed full, her head was covered by scarves and hats, her feet were constantly encased in a selection of shoes. This fascination seemed to permeate all of Jossie's activities during her first six months in the pre-school room. Katie, Jossie's new key person, recorded during a mealtime that Jossie's favourite foods were sandwiches and 'Friday' chips (fish fingers and chips being a Friday tradition at the nursery) when Jossie enjoyed folding chips around peas.

Many of the problems in Jossie's self-initiated play in the first three months of the main study stemmed from her following what could potentially be an enveloping and containing schema (Athey, 1990). She often used brute force to push objects into other objects (often unsuccessfully), after which she usually sought help from Katie.

Observations made in the first five months of the main study show that Jossie had worked out whom to approach for help in the pre-school room when faced with a problem. Katie, Jossie's preferred helper, remarked that it took her a few weeks to 'translate' Jossie's requests particularly the use of a word which sounded like 'doughnut'. This word was in fact 'do it' and was always accompanied by Jossie thrusting an object into Katie's sight line.

Box 5.5: Observation 55: Example of key person support

Ob.55/J Feb 2010	Observation number 55 Abbreviations: Jossie (J) aged 2 yrs 3 months Katie (K) key person	Coding Problem Elements of p/solving Children's main p/s ways KP support Sweeper category
Timings	Problem: Sorting and matching three teddy bears according to size	
8.53	Observation starts	
	J is lying across K's lap and appears to be viewing the activity from a horizontal position	Plan/Review?
	K – 'OK, young madam, you start and I'll watch, which bear will fit in the tiny bed? What you gonna do first? Ummm put the big bear in the big bed? He looks big, that's a good idea - now you have (only?) two so that makes it easy. So, are you going to guess or put them here so you see which bear is bigger?'	Prompting/ suggestion
	J looks and waits and fingers the biggest bear – she adjusts her position so she is sitting upright on K's lap	Plan/Review?
	J glances up at K – no movement	
8.57	K smiles at J and physically demonstrates which bear belongs to which bed – then removes the bear from the beds and lines them up in height order	Modelling
9.00	J leans back on K and looks attentively at the row of bears	Review?
	K gives J the big bed to hold and verbally encourages her to find the big bear which is on the table next to the middle and the small bear	Verbal instructions
9.04	A visitor enters the room. K lifts J from her lap and places J on the chair and stands up but holds J's hand	Maintaining nearness

	gently and talks to the visitor	
9.09	J continues to look at the three beds and places the big bear on the smallest one bed K sits down, J sprawls across her lap	Review
9.11	K places the middle size bear into the big bed and draws J's attention to the fact that it doesn't fit – she will fall out – demonstrating this much to J's amusement K – makes eye contact with J – 'What shall we do next?' J moves the big bear from the small bed and replaces it with the small bear – followed by placing the big bear in the big bed next to the middle-size bear K moves the middle-size bear to the middle-size bed - the job is done	Prompting Ownership of problem
9.13	Observation ends 9.13 <u>Discussion with Katie</u> K stated that J can do matching all by herself - the problem was easy but K 'knew' that J needed 'someone to be with her' K added, 'It has to be someone who she (Jossie) knows - J is not being lazy or anything like that she just needs someone to help her – to give her a boost'	Emotional support

<u>Jossie – aged three years one month</u>

Reviewing the observations made on Jossie at the end of the main study showed that there appeared to be a relatively high number of short bursts of problem solving episodes in her self-initiated play. Most of these took place in the role-play area and involved manipulation of materials and reflected her fascination with collecting and storing objects in containers. It appeared that the problems that Jossie created were based on how best to fit shapes into each other, which she solved by repeatedly rearranging

objects. Like Sam, the three-year-old Jossie occasionally used private speech (Vygotsky, 1986) in her self-initiated play to signify her intentions and accompany her actions.

In what ways did Jossie's key person support her problem solving?
Jossie's reliance on Katie as a source of help continued throughout the main study. The knowledge and expertise of her peers were seldom drawn upon and, if offered help. Jossie disengaged from the problem. Katie confirmed that Jossie did not yet see the benefits of collaboration and prefers 'to work alone'. Although very happy to participate in the daily adult-led activity, Jossie often waited for Katie to help her complete the given task. Katie reported that she planned activities, such as sorting and matching, to build on Jossie's problem solving, reasoning and numeracy skills (DCSF, 2008a). A feature of these adult-planned activities was the physical nearness between Jossie and Katie, as observation 55, records.

Katie appeared to immerse (my description) herself in the play of her key children and observations show her often sitting quietly in the role play area watching them at play. Observations record that in doing this she helped children to manage tasks such as putting on the dressing-up clothes and to negotiate a way forward in disputes. Katie stated that she saw her involvement as 'playing with the children' which she had time to do, as she did not have the same responsibilities.

When matched against the suggested role of the adult in sustained shared thinking (Siraj-Blatchford *et al*, 2002), all elements are seen in Katie's interactions with children during problem solving episodes. However, two areas outside the sustained shared thinking framework are particularly striking. First, Katie was able to talk at length about Jossie's fascination with enveloping and containing objects. Although Katie did not associate this with schema (Athey, 2007), she recognised that Jossie's fascination represented a pattern in her play. Katie reported that she used Jossie's interest to introduce new words, such as 'full' and 'empty'. To this end, Katie often 'borrowed' the baby room treasure basket resources, which included differently sized containers.

Box 5.6: Observation 53: Katie supporting Jossie's problem solving by thinking aloud

Ref Ob.53/J July 2010	Observation 53 Abbreviations: Jossie (J) 3 years Annie (A) 3 years Katie (K) key person Problem: Removing a dress I greet K, who points quietly to J and A who are emptying the dressing-up box in the role play area. K is sitting on the floor next to the box. J and A are standing next to her, on her right.	Coding Problem Elements of p/solving Children's main p/s ways KP support Sweeper category
Timings 10.08	Observation starts 10.08	
10.15	J is trying on layers of different clothes (to go to a party? (A gave out invitations to her birthday partly this morning)	
10.17	The fairy dress (very popular with J) becomes wedged when J attempts to remove it. J - 'Help, help, help, umm' A tugs at the dress K is sitting on the floor watching J. J attempts to pull the dress down over her hips. K – 'Well, this is a problem – what shall we do here hmmm?' A walks away K – 'Well, well, we need to think – what will work, hmmm? (pause) In response to J's attempt to pull the dress down over her hips – 'No it's stuck that way – is there another way humm? – have a think (pause) – we need to think about this' (K taps her head and J's head)	Asking for help Posing a question Joint involvement
10.21	J – continues (unsuccessfully) her attempts to pull the dress down over her hips K - 'We need to try something else not sure	

	yet – we need to try errrr - we need to – let me have a look'	
10.22	K – 'We need to check the zip – here – yep it is stuck really really jammed. I think really (J attempts to look at the zip) so lift the dress up and over – do you remember when P got her coat stuck and her mummy lifted it over her head? – wriggled like a worm in the bottom of the garden – let's try wriggling'	
10.25	J and K wriggle together while the dress is pulled successfully over J's head K – 'J, come and look here, what can we do to make the zip work umm? We don't want it to stick again it's a party dress – what can we do umm? I don't know so think umm' K – 'We could cut this bit here and put on buttons – what do you think umm? We could make this bit bigger as well, really' K – 'We could do that'. J – nods K – 'We could make a skirt? – what do you think? Let's ask Annie (Room Leader) as it's a really special dress but the zip gets stuck so that's the problem' J - nods Together K and J go outside to find Annie	
10.35	Observation ends 10.35	

What is striking in observation 53 is Katie's use of a running commentary when supporting Jossie's problem solving. This Katie describes as 'just me thinking out loud, I suppose'. When observation 53 was discussed with Katie she stated that her use of a running commentary to help Jossie remove the dress and involve Jossie in thinking about ways to ensure that the dress would not become stuck again was intuitive.

In using observation 53 as an example of adult modelling, it becomes clear that Katie assumed the role of a facilitator to prompt Jossie to work through with her the stages of problem solving, involving task analysis, encoding, analogical and deductive reasoning. As Katz (1995) concludes, learning dispositions are best learned when they are:

> Modelled for children by those around them – by teachers who think aloud about their uncertainties and their problem solving. If teachers want their young pupils to have robust dispositions to investigate, hypothesize, experiment and so forth, they might consider making their own intellectual dispositions more visible to the children.
> (Katz, 1995, p. 65)

Discussion of Jossie's problem solving

Many observations record Katie's 'scaffolding' (Wood, Bruner and Ross, 1976) Jossie's problem solving by breaking problems down into smaller steps, drawing attention to key features, asking questions, giving clues and modelling problem solving behaviour. Katie worked in collaboration with Jossie, creating what Claxton and Carr (2004) described as a 'potentiating' (powerful) learning environment (p. 91).

This potentiating learning environment is not an exclusive child-led agenda but one that involves frequent 'intent participation' (Rogoff, Paradise, Arauz, Correa-Chávez and Angelillo, 2003 p. 176), often referred to as a 'shared activity' (Claxton and Carr, 2004). In this it is recognised that children, as well as adults, have a responsibility for directing activities and events that surround them. However, coordination of action and shared goals between children and adults are nurtured by a social environment with a collaborative structure and flexible roles which Rogoff *et al* (2003) describe as 'horizontal' in contrast with:

> Assembly-line instructions and hierarchical structure, organized with fixed roles in which someone manages others' participation, acting as a boss. (Rogoff *et al*, 2003, p. 184)

Acting as a 'boss' does not, of course, necessarily refer to formal management structures, but to the roles assumed and adopted by children and, in the context of my study, those adults who care for them in nursery settings. Wood *et al* (1976) argue that effective scaffolding of children's

learning only takes place when it is child-initiated, illustrated in the following observations of Jack.

Jack

Jack aged 2 years 1 month

Jack is described as being 'quiet' both by his mum and the adults who care for him at his nursery. This is an apt description for Jack, who has a soft voice, slow deliberate movements, a shyness which shows in his soundless tears, a dislike of loud noises and in his burying his head in his hands. Jack appears to prefer being close to known adults.

Observations indicate that Parvinda, Jack's key person during his time in the toddler room of his nursery, used toys such as nesting cups, post box sorters, train sets and resources such as sand, water and playdough to 'hook' Jack into problem solving, appealing to what Brown (1987) identified as intrinsic problem solving behaviour. An example of this intrinsic problem solving, mirroring Brown's (1987) findings, occurred in later observations of Jack at the age of 2 years 2 months when, given a set of nesting cups, he was able spontaneously to put them in size order. Additionally, observations record Jack happily engaged with the offered play, dismantling objects and putting them back together – the large Lego car and garage being his favourites. During conversations with Parvinda, she made reference to Jack's interest in dismantling and reconstructing objects as being part of his early mathematical development and linked to counting games and rhymes, and shape recognition.

Many of the problems involving Jack in the early stages of the main study were planned. Parvinda and, later, Lindy, appeared to 'know' what sorts of toys and resources are attractive to very young children. Both Parvinda and Lindy agreed that sometimes toys and games designed to promote problem solving skills in very young children, such as matching three dimensional plastic shapes to holes (shape sorters) or grading different sizes of hoops to fit on to a pole (stacking rings) seemed to be of limited value. Swan (2005) also questions the usefulness of these toys as they

present children with 'dubious problems' (p. 117), offering no choice or responsibility, so 'they are not problems at all' (Swan, 2003, p. 117). Swan (2005, 2003) takes the stance that problems should pose inconsistencies and create cognitive conflict. This Gifford (2010) aptly describes as 'creating muddles for children to resolve' (p. 167).

However, Jack at the age of 2 years 1 month did not appear to be emotionally ready to deal with inconsistencies and 'muddles', or independently explore his immediate nursery environment. Both Parvinda and Lindy appeared to understand his need to be closeted and matched the way in which they supported his problem solving to this. Evangelou *et al* (2009), drawing on the research of Laible and Thompson (2007), recognise that emotional warmth is even more powerful when it is genuinely responsive to the emotions of children 'who are seeking predictability and control of everyday experience' (Laible and Thompson, 2007, p. 194). Nevertheless, Parvinda and Lindy's support of Jack did not preclude encouraging him to explore different areas of his immediate environment including, on his entry into the pre-school room, the enclosed nursery garden, which was often referred to by the nursery staff as their 'outdoor classroom'.

<u>Jack aged 2 years 11 months</u>

Jack as an older child appeared to enjoy playing in the outdoor area of his nursery. During the last main study session, two observations of Jack's self-initiated play included five problem solving episodes, all centred around what Gura (1992) describes as 'block play', which at Jack's nursery was very well resourced.

Observations show that Jack preferred to sit with Lindy for the first hour or so of the morning session, usually, at her suggestion, building railway tracks or sharing a book with her. However, after morning snack he was often encouraged by Lindy ' to have a look outside'. Observations record that Lindy always reassured him by saying where she would be - 'I will be right here inside'. If she needed to leave the room she often told Jack and asked another adult to 'let her know if he needed something'.

Observations record that Jack, as an older child, often wandered around the garden, avoiding the busyness of the groups of children riding the wheeled trikes and bikes. Lindy stated that his introduction to block play came from a nursery initiative to encourage children to use the newly purchased large building bricks which were supplemented by empty cardboard boxes and a miniature woodwork bench with plastic saw and an imitation electric drill. It was these resources that appeared to capture Jack's interest and, complete with yellow 'hard hat', he set about building towers, roadways, bridges and, his final project at the end of the main study, a garage.

Observations show that Jack seemed to enjoy the opportunity to mix and match different sizes of wooden bricks with same-sized plastic bricks and a selection of cardboard boxes, which he initially used to make patterns, often describing these as roads. This quickly led to more daring block play of a kind that Gura (1992) describes as 'stunt building' (p. 21) which, in Jack's case, consisted of building towers. For this, he used chairs or any other object that he could clamber on to, in order to place just one more brick on top of a tottering pile of bricks, which inevitably came crashing down. As Jack became a more experienced builder, the height of his towers increased, although inevitably they still collapsed – as one researcher can verify, as I didn't move quickly enough to avoid the avalanche of bricks.

Stunt building, daring, risk taking block play, Gura (1992) notes, is 'an entirely useless activity in functional building terms' (p. 110). However, it appeared to give Jack the opportunity to manipulate objects, explore patterns and build tall structures using his knowledge of symmetry and balance. Stunt building also, I would argue, gave Jack the freedom to 'take risks', an advantage of block play evidenced in later block play research projects (Park, Chae and Foulks-Boyd, 2008; Miyakawa, Kamii and Nagahiro, 2005).

As the earlier observation of Jack recorded (Observation 139), Jack

appeared in his block play to be using the problem solving process of plan, do and review (Muir *et al*, 2008). Isolating what 'plan, do and review' looks like was one of the many difficulties found in analyzing the observations, so the following is offered as a possible further illustration.

In his block play Jack demonstrated 'planning' by:

- Verbal and nonverbal responses to known adults
- Selecting appropriate resources – including tools
- Excluding resources
- Arranging objects so that they are in easy reach

Jack demonstrated 'doing' by:

- His persistence in a building task
- Moving, adjusting and replacing objects

Jack demonstrated 'evaluation' by:

- Repeating a completed task
- Standing back and 'surveying' his brick structures (usually towers)

<u>In what ways did Parvinda and Lindy support Jack in his problem solving?</u>

Observations show that Parvinda and Lindy provided the constant attention and emotional 'warmth' that they felt that Jack needed to feel secure in his nursery environment. They understood his distress and responded to it by giving him attention, staying close to him, structuring play situations around his interests and scaffolding his learning. However, Jack was a willing participant in adult-led play and as an older child often invited Lindy into his block play, usually by waving at her to gain her attention.

It was established through discussion that both Parvinda and Lindy felt that they played a crucial role in Jack's life -'It's awesome!'(Parvinda, February 2010, extract from research journal recording a conversation with Parvinda and Lindy about their role as Jack's key person). However, during this conversation they later distance themselves, in their responsibility to Jack, from being a replacement for his mother, their

approach being guided by the principles of understanding, sustaining and supporting.

The contingent relationship (Evangelou *et al*, 2009) that existed between Jack and Parvinda and, later, Lindy appeared to be what Lee (2006) describes as 'synchronous' in which both child and adult are co-constructors in the relationship with each other. Through conversations with Parvinda and Lindy, I established that both practitioners knew Jack's care routine and interests well and were alert to changes. In turn, Jack appeared able to predict what was happening in the course of his nursery day and how to seek help and comfort from Parvinda and Lindy. This relationship, Schore (2001) sees in terms of a 'mutually attuned synchronization' (p. 9).

This mutually attuned relationship, Schore (2001) maintains, meets not only the emotional needs of young children but also facilitates their learning in terms of information processing, as the adult is able to adjust the mode, amount, variability and timing of stimulation. Both Parvinda and Lindy, I would maintain, achieved this in their support of Jack's problem solving by their use of four strategies: modelling, scaffolding, coaching and, eventually withdrawing or fading away support. These strategies, highlighted by Rogoff (1990), are part of the process of cognitive apprenticeships between children and adults and are also reflected in elements of sustained shared thinking (Siraj-Blatchford *et al*, 2002), with the exception of withdrawal/fading of adult support.

In their modelling of problem solving solutions, Parvinda and Lindy did not often use a 'thinking aloud' commentary, which was a feature of Katie's support of Jossie. Their support could perhaps described as more 'hands on'. For example, if Jack had a difficulty in fitting equipment together, such as large Lego bricks, Parvinda would first demonstrate and then put her hand over Jack's and physically guide his movements.

Lindy, however, would perform the same task as Jack, such as connecting pieces of Brio wooden train track, first laying out all the pieces she intended to use and encouraging Jack to do the same. This modelling seemed to be part of how both Parvinda and Lindy 'scaffolded' (Wood *et al*, 1976) Jack's performance as a problem solver. In observations of adult-directed play their support can be described as including:

- Gaining Jack's interest in a task by providing a range of colourful toys that captured his interest and providing a quiet area in the nursery where Jack was offered attention and cuddles
- Demonstrating ways of solving a given problem and/or completing a given task
- Encouraging Jack to 'have a go' by words, smiles and hugs – acknowledging his efforts by words, smiling and clapping
- Simplifying a problem by reducing the number of steps required to solve it
- Drawing Jack's attention to salient features of the task by breaking the problem into stages (chunking)
- Allowing Jack the freedom to make errors
- Helping Jack to control his frustration by intervention (e.g. joining pieces of railway track together for him to form a bridge) or distraction (e.g. tickling, suggesting a new activity)

Observations also show Parvinda and Lindy modifying their support in response to how Jack was managing situations, both emotionally and cognitively. During the early stages of the main study, Jack appeared to find the first two hours of the nursery session difficult, while he made the adjustment between being at home with his mum and being in his nursery which he attended one day a week. In response to his need for reassurance, his two main carers offered him familiar activities such as sorting and matching (shape sorters, stacking rings and inset jigsaw) and toys such as the wooden train layout which reflected his changing interests in an area which Athey (2007) would associate with 'action schema' (p. 115) - vertical movements, circular direction, going around a boundary and containing objects.

However, observations record that as Parvinda and Lindy became 'tuned in' (Selleck and Elfer, 1997) to Jack's emotions and learning styles, they modified and adjusted their support of his problem solving, adapting it to what Shaywitz *et al* (2002) describe as a 'rhythm response' (p. 102). This takes account of individual learning styles as well as preferred pace of learning and preferences. For example, several observations record that when introduced to the daily group activity, Jack was given the opportunity to choose whether to participate or not. This, I maintain, gave him time for lengthy periods of play in which to explore, develop ideas and follow through his interests. It also gave him time to develop a sense of autonomy as a learner and what Gura (1992) describes as ownership of his ideas – those experiences and discoveries that were being generated from his play.

Discussion of Jack's problem solving

Observations taken in the later stages of the main study record Jack as being more confident in using equipment and accessing toys to pursue an interest, with adult support gradually reducing or, in Collins's (2006) words, 'fading away' (p. 47). This fading away of support, I would suggest marked a transfer of responsibilities for managing activities from Lindy to Jack himself who, through his play began to create and resolve problems independently.

Although in my observation of Jack the fading away of support (Collins, 2006) appeared to be adult-initiated in response to his developing confidence, Rogoff's (1990) thinking suggests that it was negotiated, in that:

> While adults assess children's current understanding of materials and adjust their support of children's developing skills, children simultaneously adjust the pace of instruction and guide the adults in their supportive efforts. (p. 107)

Observations made in the early months of the main study record that Jack's day in his nursery appeared to be organised by Parvinda in that she selected activities for him that she considered appropriate for his age, and in a sense controlled the range of problems he encountered. In offering

Jack her selection of toys, and later adjusting her choice to take into account Jack's interests and skills, Parvinda appeared to be guiding Jack's development.

However, as Rogoff (1990) argues, even the youngest children actively choose their own activities, 'directing themselves and their caregivers toward desirable and away from undesirable activities' (p. 91). Their success in determining their own activities, as Rogoff (1990) points out, relies on the supportiveness or willingness of others to allow their choice of activities and level of participation. So an element of reciprocity appears to be an ingredient in Rogoff's (1990) view of the child/adult learning relationship, a view supported by Underdown (2007) in her observations of the interaction between babies and their mothers.

Although reciprocity can be seen as a feature of collaborative learning (Whitebread, 2007) involving a sharing or giving and taking of ideas, Goss (2005) argues that it also involves a sharing of responsibilities. In this, both children and their caregivers negotiate the level of support 'in regard to each other' (Rogoff, 1990, p. 87) so that it is recognised that a child's participation in an adult-led or adult-chosen activity requires some cooperation from the child. While the adult retains the role of the knowledgeable other it is the child who adjusts the pace of instruction so that the process of learning is a shared responsibility (Rogoff, 1990). Seen in this light, the use of adult support strategies contained within sustained shared thinking (Siraj-Blatchford *et al*, 2002) may, if used without sensitive adjustment to the child's rate of learning, remove the children's control and responsibility in finding their own solutions to problems (Shaywitz *et al*, 2002).

I would suggest that Lindy's fading of support for Jack's problem solving reflected in part her wish to encourage Jack to explore the nursery environment independently. It appeared that Jack seemed to prefer to work with familiar adults, as observation 139, may indicate and had favourite toys and activities. However, when I discussed the final

observations of Jack with Lindy she spoke not in terms of assessment and adjustment of her support but of introducing him to what she saw as new areas of learning, such as counting and colour recognition and the associated language. This approach, Lindy thought was influenced by her interpretation of problem solving and the nursery's involvement in the Every Child Is A Talker (ECAT) initiative (DCSF, 2008b) in which she was the lead practitioner. Lindy felt that Jack was behind in his spoken language, so this was an area of his development she needed to 'work on'.

When asked if her responses to supporting Jack's future learning would be the same if the EYFS (DCSF 2008a) and ECAT (DCSF, 2008b) were not in place, Lindy thought probably not. However, she was not sure what would guide her actions in the absence of the EYFS (DCSF 2008a) and ECAT (DCSF, 2008b) She had always worked with an early years curriculum framework, which she felt gave her clear guidance.

However, reliance on prescriptive curriculum frameworks such as the EYFS (DCSF, 2008a), Fenech and Sumsion (2007) argue creates a narrow view of what constitutes 'good' childcare practice. What is important in their view is not working towards definitions or standards imposed by government regulation but the creation of a climate which gives greater empowerment to the childcare workforce to do what they do best, care for children.

In reviewing the observation made of Lindy's (and Parvinda's) support of Jack's problem solving I was in no doubt that their support was matched not only to the pace of his learning but also to his emotional requirements – providing the comfort and security that Jack needed to become an independent explorer. The question here is, on an every day level, does working within a prescriptive early years curriculum such as the EYFS (DCSF, 2008a) really limit the quality of interaction between children and their key person, or does it simply control the activities being offered to the children?

Fenech and Sumsion (2007) further argue that a prescriptive curriculum erodes the professional judgments of practitioners and inhibits spontaneity in responding to the individual and group needs of children. I am not so sure that professional judgments and intuitive ways of working are as severely curbed as Fenech and Sumsion (2007) suggest and in my experience of visiting nurseries I feel that some practitioners in their support of young children's emotional well-being 'work around' the EYFS (DCSF, 2008a), basing their practice on their professional judgments and intuitive knowledge. What remains unclear to me is what guides professional judgments and what exactly is the 'intuitive support' that all the practitioners involved in my study felt they drew on in their support of the children's problem solving.

George

George between the ages of 2 years 4 months and 2 years 8 months

As previously documented, George's parents switched his days of attendance to fit in with their work pattern. This meant that George was present at five observation sessions, four being in the last four months, thus capturing him as an older toddler.

George, according to his mum, became a confident walker just after his first birthday and appeared to enjoy the free flow indoor/outdoor arrangement of his nursery. During the observation sessions George was encouraged to participate in adult-led activities because, as Britney his key person reported, his parents were concerned that he was being 'left behind', as there was no vacancy for him in the pre-school room on the days that he attended.

Observations showed that George enjoyed using push along bikes, cars, balls, water and wet sand to which he was almost magnetically attracted. Although sharing the same key person as Flo, he was not her playmate, already having a best friend –Thomas – who had transferred to the pre-school room.

Observations indicate that much of George's problem solving arose from his wish to move objects and fit objects into objects, possibly following an enveloping and containing schema (Athey, 2007, p. 139). All of the observations of George's self-initiated play involved his friend Thomas, four months older than George. Thomas appeared to be physically stronger than his younger friend and, I would maintain, proved to be an excellent 'knowledgeable other' (Vygotsky, 1978). The observations of George and Thomas are the only examples during the main study period of an older peer in this role.

George used what is commonly referred to as 'body language' (Bruce, 2001, p. 21) when seeking help from others, including Thomas. This included gestures, eye contact, pointing and a 'Hollywood' smile replacing spoken language (Observation 80).

Box 5.7: Observation 80: George's use of smiling in seeking assistance from an unfamiliar adult

Ref Ob.80/G July 2010	Observation 80 Abbreviations: George (G) aged 2 yrs 4 months Kim (K) researcher Problem: Reaching for a coat I am sitting in the book corner writing up some notes. G walks into the room and stands near the coat pegs.	Coding Problem Elements of p/solving Children's main p/s ways KP support Sweeper category
Timings 10.55	Observation starts 10.55	
	George (G) stretching to reach his coat on his coat peg – stands on tip toe and stretches his arms and hands into the air – unsuccessful	Problem
10.58	G looks around the room – stretches his arms and hands into the air – makes eye contact with me. I am sitting nearby	Asking for help?
	G points to a (his) coat – I ask G if he would	

	like me to reach his coat G gives me a 'Hollywood award' winning smile – which simply melts my heart – I again offer to help G I take G's coat from the coat peg and help G to put it on and fasten the zip Observation ends 11.03 <u>Discussion with Britney</u> Britney on reading this observation remarked – 'Yep that smile gets you every time'	
11.03		

<u>In what ways did George's key person Britney support his problem solving?</u>

Although George attended a different nursery from Sam, the approach that Britney adopted to his problem solving appeared to be similar to that of Sam's key person, Caroline. Like Caroline, Britney appeared to be receptive to George's requests for help and modelled skills such as demonstrating how to use equipment in the outdoor sandpit to make a sandcastle. Encouraging children's independence, Britney stated, was high on her list of priorities, particularly as it reflected the nursery's adoption of the High/Scope curriculum approach (Weikart *et al*, 1978), a model which views children as active learners who learn best from activities that they themselves plan, carry out, and reflect upon. Dolly, manager of the nursery, stated that the High/Scope (Weikart *et al*, 1978) approach had been fully implemented in the pre-school room. It was also reflected in the way the nursery was organized in that equipment and resources were arranged in child-height storage units and in unrestricted access to the outdoor area. For non-mobile children there was an enclosed baby area but its use was limited to warm days.

It appeared from observations that George saw Britney as a source of help. However Britney, during the main study period, was often based in the baby room in order to maintain their adult/child ratio. This relative lack of contact with George, one of her two key children, perhaps illustrates the

organisational (and managerial) difficulties in maintaining the key person system, which needs to take into account children's varying attendance patterns, staff shift systems, staff absences and staff turn-over. This leads to the conclusion, as Penn (1997) suggests, that there is sometimes a significant gap between the theory and the actual operation of key person work in English nurseries. Penn (1997) goes on to comment that, despite good ratios, it 'did not work in practice' (Penn, 1997 p. 88). This draws attention to the dilemmas that some early years practitioners face in juggling the many responsibilities within their job roles.

Discussion of George's problem solving

Britney stated that George had good language comprehension in that he could follow instructions well. She also felt that George was happy at the nursery and that he was an enthusiastic participant in adult-led activities. She knew that George could sustain lengthy periods of play and she was aware of the importance to him of his friendship with Thomas. However, Britney stated that the picture she had of George was built up from her observations of him that 'she keeps in her head'.

Practitioners involved in my study stated that they enjoyed reading its observations. However, the majority of practitioners (including the three nursery managers) felt that carrying out lengthy observations was not a viable option in everyday practice. Although Britney, was a source of help to George, he was also supported in his problem solving, by his friend and companion Thomas.

George and Thomas, according to George's mum, had been friends from birth, both families attending the same church, which resulted in their being frequent visitors to each other's houses for 'playdates' and evening baby sitting. George and Thomas started nursery together but were cared for in separate rooms. However, observations record that they played together in the garden and that their play revolved around using the wheeled toys, the water tray and the sand pit.

Many of the problems identified in the main study observations seemed to stem from difficulties encountered in manoeuvring the nursery trikes around objects, or up and down the garden slope, or in transporting materials such as sand or water from one place to another. Brute force was often resorted to in moving objects, with George making 'huffing and puffing noises' or exaggerated pushing and pulling movements as a means of enlisting Thomas's help. George was increasingly using tools such as buckets and spades in which to transport water and rope to pull trikes up and down the garden slope, often following the actions of Thomas. Arnold (2003) delightfully describes tools as 'extensions of arms' (p. 47).

In observation 81, the role of George's older friend Thomas as a 'knowledgeable other' is striking. Vygotsky's (1978) concept of zone of proximal development (ZDP) does not distinguish adults from more capable peers. He saw for both a role in bridging the gap between actual development levels determined by independent problem solving and the level of potential development under adult or more capable peer guidance.

Box 5.8: Observation 81: George aged 2 years 4 months using tools to move sand from the sandpit to the trike basket supported by Thomas in his role as a knowledgeable other

Ref Ob.81/G July 2010 Timings 10.50	Observation 81 Abbreviations: George (G) aged 2 years 4 months Thomas (T) aged 2 years 8 months Britney (B) KP Problem: Transferring sand to the trike basket I am sitting next to the outdoor sand pit Observation starts 10.50 G and T are playing in the outside sand pit G moves handfuls of sand from the sandpit to the grass	Coding Problem Elements of p/solving Children's main p/s ways KP support Sweeper category

10.56	B is walking past the sandpit with buckets of water to wash down the slide which has been vandalised during the previous night –'No, G, no we will have no sand left'- shaking her head B walks past the sand pit and G carries on moving sand with his left hand from the sand pit to the grass	
11.05	G moves over to the nearby trike (ten steps away), which has a canvas front basket with a handful of sand, which he puts into the basket – repeats procedure three times	Enclosing, dynamic back and forth schemas? x ref research notes 20 - 100
11.11	T jumping in and out of the sandpit, looks across at G picks up a nearby spade looks around the sandpit and finds a small bucket, T puts one spadeful of sand into the bucket and joins G in transferring sand to the canvas bag (T appears not to have quite worked out how to transfer the sand from the bucket to the bag so most of it covers the trike) T repeats action four times – G looks on	
11.16	G stands and watches – looks around the sandpit for a bucket, finds a yellow bucket, takes handfuls of sand and fills the bucket – walks over to the trike, opens the canvas flap and pours the sand in	
11.20	T walks over to join G who is next to the trike – G who grins and laughs	Companionship
11.24	Both boys return to the sand pit and appear to work alongside each other – G filling his bucket with handfuls of sand and T filling his bucket using a spade – both independently move back and forth between the sandpit and trike covering the canvas bag and trike seat with sand – T helps G carry a bucket of sand by placing his hand underneath the bottom of it	Use of tools

11.26	G disengages from the transfer of sand and sits in the sand next to a spade – he moves the spade into the sand – flings a spadeful of sand into the air (seems really surprised when it lands on his head) T continues with his task of covering the trike with sand using the bucket and spade to transfer the sand G continues to fling sand into the air until asked by B to leave the sandpit and go inside to wash his hands for snack G hugs T and leaves the outside area	
11.31	Observation ends 11.31	

The value of Thomas's support of George's problem solving I feel is clear: Thomas modelled the use of tools and provided the strength that George lacked to carry one bucket of sand. In later observations, Thomas demonstrated how his knowledge of successful strategies - for example, using ropes to pull objects such as a trike up an incline - could be used in dealing with a new problem - to stop the trike from rolling down the other side. But how far is this peer support recognised and promoted in areas of the nursery that care for children under three? This raises the debate, discussed in chapter six, about the advantages and disadvantages of mixed grouping in regard to supporting very young children's problem solving within nursery settings. What benefits does it bring, and to whom?

Children's problem solving outdoors

Another issue arising from the observation of George is the use of the outdoor nursery space. Being outdoors offers children, Lambert (2000) argues, a greater range of divergent problems and space in which to try out solutions, particularly when working out how to transport objects, to design structures with large wooden bricks and to manoeuvre up and

down gradients. Lambert (2000) also points out that outdoor play areas offer some children a private space to test out ideas away from adult supervision.

It is widely recognised that young children benefit from outdoor experiences (Ouvry, 2000). These benefits are illustrated by research such as Stephenson's (2003) involving children under two and showing that the outdoor environment presents different challenges for very young children, including basic tasks such as putting on Wellington boots and more difficult tasks such as climbing on outdoor equipment. Stephenson (2003) goes on to record in her study of outdoor play spaces that children face these challenges with a determination that seems to be a part of their drive to extend their independence and control their environment. Although all children over the age of two involved in my study had daily access to their nurseries' outdoor areas, this did not apply to six children under two who were cared for in similar age group rooms – commonly referred to as 'baby rooms'.

Bea and Paul

Bea aged 4 months and Paul aged 3 months

Bea's and Paul's involvement in treasure basket play appeared to give them the opportunity to handle a range of objects and move on from 'what is this?' to 'what can I do with this'. Julie, the manager of their nursery confirmed that treasure basket play (Goldschmied, 1987) was well established and that the nursery team was confident in its use.

Goldschmied and Jackson (1994) describe a treasure basket as containing a variety of 'natural' objects chosen to stimulate the children's senses. Recommending its use with children under two years, Goldschmied and Jackson (1994) maintain that it can offer time and opportunities to participants to discover, make connections, take the first steps in decision making and take part in social interactions with other participants. They write:

> Watching a baby as she explores the items in the Treasure Basket, it is fascinating to see the zest with which she chooses the objects that attract her, the precision she shows in bringing them to her mouth or passing them from one hand to another, and the quality of concentration as she makes contact with the play materials. We see her intense observation, her ability to choose and return to a favoured item that attracts her, sometimes sharing her pleasure with the responsive adult. She is in no doubt about her ability to select and experiment. (Goldschmied and Jackson, 1994, p. 99)

Bea and Paul in their treasure basket sessions appeared to be actively exploring or, as Meade and Cubey (2008) describe it, 'generating meaning' from the sensory input gained from their encounter with the treasure basket objects. In so doing, I would maintain, Bea and Paul were managing their immediate physical environment and facing the problems it created. More importantly, Bea and Paul had the freedom to explore, albeit in rudimentary ways, what Thornton (1995) describes as 'the dynamics of solving problems' (p. 63), that is the opportunity to:

- Interact with problems
- Set self imposed goals
- Modify goals
- Be inventive
- Be selective
- Try out different strategies including trial and error
- Shift between similar strategies
- Discover something different

(Adapted from Thornton, 1995)

In reviewing the observations made of Bea during treasure basket play it is clear that the freedom she had to encounter and solve problems was complemented by the interaction with Martha who was attentive but not an active participant in Bea's play. Observations of Bea involved in treasure basket play record how she encountered problems such as how to pick up cylinders and slippery objects. Once she had this mastered this skill Bea appeared to be fascinated with putting objects inside each other. Whether this was exploratory play or problem solving is unclear, but the

potential for developing treasure basket play to include problem solving tasks is an area worthy of further study.

Bea aged 1 year 4 months

Much of Bea's problem solving as an older child of 1 year 4 months, observations show, consisted of her moving toys from one area of the baby room to another and maintaining the balance and physical co-ordination to do this. Martha, Bea's key person, also noted this 'transportation' in Bea's attempts to feed her with a spoon (moving food from her dish to her mouth) and in constantly throwing her bedding outside her cot. As an older child, Bea appeared to be capable of setting a goal and of achieving it, displaying impressive persistence and an ability to plan and co-ordinate her body movements and to stay on task. Meade and Cubey (2008), reiterating Claxton and Carr (2004), in their observations of children under five show that competency in problem solving is more than a matter of cognitive structures and includes 'habits of minds – dispositions that play a key role in thinking' (p. 41).

One of the insights gained from my observations of Bea was that she was not as Meade and Cubey (2008) write, flitting from activity to activity but 'fitting' her experiences, impressions and memories into the patterns of new experiences, which Athey (2007) sees as part of schema building. An analogy is provided by Meade and Cubey (2008) in that very young children behave like honey bees:

> Moving from experience to experience to gather further information to encode … because they are trying to make sense of the abstract characteristics of particular features of their environment. (p. 43)

Observations made during the main study period record that Bea, with her increasing mobility, was beginning to explore (and find problems) outside the confines of the nursery playpen and play mat. For Paul, who was a month younger than Bea, and not independently walking at the end of the main study period, exploration was confined to those areas of the nursery he could reach from a sitting (and, later, bottom shuffling) position.

Paul aged three months

Observations made in the first month of the main study period record that Paul appeared to be visually alert and liked to grasp objects within his reach, often putting them into his mouth. As Bruner (1973) identifies these movements as the precursor to the development of problem solving competencies, these early observation show that Paul was developing his skills as a problem solver – which is a really exciting concept to work with.

Paul aged 1 year 1 month

Observations indicate that Paul enjoyed the company of Martha and exhibited a sustained interest in exploring the objects and resources that she provided. Many of the problems he faced as an older child appeared to stem from his wish to retrieve toys just beyond his reach, being unable to pick up objects from the treasure basket and master the art of using a beaker and spoon. Paul appeared to rely on Martha for help and communicated his wishes by sustained gazing, pointing and vocalization. If these initial actions were unsuccessful, Paul used more exaggerated arm movements, became louder in his vocalization and pulled Martha's arm (and on one occasion her hair) to make his wishes known.

Like Bea, Paul at six months often became engrossed in treasure basket play, demonstrating what Laevers (2000) describes as a depth of involvement when children are:

> Concentrated and focused, interested, motivated, fascinated, mentally active, fully experiencing sensations and meaning, enjoying the satisfaction of the exploratory drive, operating at the very limits of their capabilities.
>
> (Laevers, Debruyckere, Silkens and Snoeck, 2008, p. 6)

However, in their nursery, undisturbed time during the field period study for treasure basket sessions was at a premium. Both Paul and Bea were often interrupted during treasure basket sessions by daily care routine tasks, such as nappy changing, mid-morning naps and drinks, as well as weekly music and baby signing sessions (the latter organised and delivered by external agencies). All of these seemed to take priority.

In what ways did Martha support Bea's and Paul's problem solving?
Like Britney, Martha found it difficult to find time to make written observations of her key children. However, during the ten month main study periods Martha made two written observations of Bea and one observation of Paul at play which she used as an *aide mémoire* when discussing with me the factors which influenced her support of their problem solving.

Martha was well informed about Bea's preferred use of hands, her gestures, her favourite objects and how she enjoyed enclosing objects under lengths of material during periods of treasure basket play. Later when Bea became more mobile Martha noticed how she loved to hide under the curtain at the far corner of the baby room and surround herself with her favourite toys.

Martha identified Bea's interests and actions with schema development (Athey, 2007) and introduced Bea to activities such as puppets, making simple shakers - which all involved enclosure and hiding toys around the room for Bea to find – and transportation. These activities, alongside treasure basket and later heuristic play sessions (Goldschmied and Jackson, 1997), Martha felt, generated problems that she saw in terms of 'challenges' to extend Bea's thinking.

In viewing problem solving as 'challenges', Martha planned activities that she thought would capture Bea's interest. To do this, Martha involved Bea in activities such as helping to work out the best way to keep rice in the plastic bottle when making simple shakers. Sometimes, observations show that Martha helped Bea by demonstrating possible solutions, such as using different types of coverings and fastenings as lids to the bottle shakers. Martha also offered verbal suggestions and her own experience as forms of support. These are seen as effective strategies within the sustained shared thinking framework (Siraj-Blatchford *et al*, 2002).

The value of adult demonstrations of problem solving strategies for very young children has been questioned (Willatts, 1997). Although the

research of Williamson, Jaswal and Meltzoff (2011) has established that some young children can quickly and efficiently adapt their behaviours from watching the actions of others, this can in some instances be counterproductive. Williamson *et al* (2011) acknowledge that some children are very highly attuned to the specific actions of others, resulting in a tendency to 'over-imitate' (p. 57), reproducing actions that are unnecessary and which result in failure to achieve a desired outcome.

The conclusion that Williamson *et al* (2011) reach in their research on the development of sorting strategies amongst three-year old children is that, in sorting objects, children profit from an adult demonstration of a sorting strategy but in so doing need to extract the adult's organisation - or sorting rule - and 'apply it to their own sorting strategy' (p. 64). Williamson *et al* (2011) conclude that very young children do not rely solely on imitation of adults and that cognitive structures are already in place to support what Bruner (1990) terms as 'agency - actions directed towards goals' (p. 77).

The concept of 'agency' (Bruner, 1990) contributes to the image of the very young child as an active learner already 'wired up' from birth, so well illustrated by Gopnik *et al* (1999). It is a theme that appears to be running through current research into brain and cognitive development (Evangelou *et al*, 2009). This suggests that children can behave as if they know how to solve given problems but research has not yet shown how conscious this learning is (Goswami, 2010).

As with Bea, Martha supported Paul in his problem solving by demonstrating possible solutions, offering her own experiences. She also appeared to have an genuine interest in Paul development. This genuine interest showed itself in Martha's knowledge and understanding of Paul as a person – his personal traits and the way he communicated happiness, sadness, thirst, discomfort and tiredness to her. Martha 'knew' that Paul needed the security of being close to her. During the first three months of the main study, Martha would often sit on the floor with Paul between her

legs supported by her body and surround him with colourful toys that she felt would attract Paul's attention.

In the later stages of the main study, Martha provided treasure basket objects that Paul could lift easily and others that he had to adjust his handgrip in order to lift. She introduced Paul to tools such as beakers and spoons to encourage him to be independent at mealtimes. To help him use a beaker Martha placed her hand over his to model the wrist-turning action needed to tip the water from a beaker. This action was often repeated, with the result that Paul could use his beaker with Martha's aid, but not independently. Martha acknowledged that as an older child Paul was becoming more skilled in what Ruff *et al* (1992) term visually guided grasping and reaching. In response to this, Martha placed objects such as pinecones, large buttons and shells in the treasure baskets offered to Paul. Observations made during these periods illustrate the possibilities of using periods of treasure basket play to encourage problem solving, a concept discussed in chapter six as a topic for further study.

Box 5.9: An overview of the value of treasure basket play with regard to problem solving by two children under eighteen months

Observation number	Description of problem and length of involvement
11B	Working out how to push a piece of material into a wooden box 6 minutes
12B	Working out how best to grasp a length of metal chain 3 minutes
15B	Working out how to hold two pine cones in one hand 5 minutes
17B	Attempting to find a way to balance two large fir cones 10 minutes
25B	Finding a solution to prevent metal chains from slipping through fingers 12 minutes

10P	Adjusting handgrip to pick up three different sizes of boxes 10 minutes
11P	Adjusting handgrip to pick up four different beakers with different sized handles 7 minutes
21P	Working out how to contain three wooden balls in to a square box 12 minutes
25P	Working out how to balance three square wooden boxes 15 minutes
29P	Exploring ways to cover a wooden ball and a fir cone with a length of material 10 minutes and later choosing a different type of material to do the same task 5 minutes

Discussion of Bea's and Paul's problem solving

Martha did not see problem solving as an isolated activity. It was her belief that problems, which she viewed as 'challenges', arose spontaneously in children's play, resulting in what Rogoff (2003) describes as 'moment-to moment learning' (p. 23). This concept has several layers. First, learners must themselves construct or generate meaning from sensory inputs as 'no one else will do it for them' (Meade and Cubey, 2008, p.40). Second, learning moments are 'cumulative' (Nuthall, 2007, p. 16) in that the learner encounters a new experience and holds on to pieces of thought from which a new concept develops. Third, individual development, Rogoff (2003) argues, is inseparable from cultural and historical development, in that:

> History has left a legacy of symbolic and material technologies, as well as values and scripts that learners assimilate or encode in their moment-to-moment learning. (p. 50)

Rogoff (2003) maintains that adult support of children's moment-to-moment learning includes 'intuitive' adult support, a phrase used by all the practitioners involved in my study when describing what guides their support of children's problem solving. Martha, their key person, for example, described her 'intuitive' support of Bea and Paul problem solving as 'it's sometimes the right way to act but sometimes not'.

When asked what elements constituted intuitive support, Martha shared her thoughts via e-mail What is clear to me from the extract is that Martha has watched Bea at play and knows her interests (and possible schemas) and patterns of learning. Martha's intuitive support is based on her knowledge and understanding of her key children which, as previously noted, Selleck and Elfer (1977) refer to as 'tuning into children'.

Box 5.10: Martha's view of what constitutes adult intuitive support

> 'Intuitive' means it's sometimes the right way to act but sometimes not.
>
> I know what makes Bea tick, so I know how best to use that really and I know that Bea likes me to play with her so I can use that to show her new things and talk to her at the same time, so that Bea is involved – would you call that engaged?
>
> I engaged with her learning so that it is personal to her so any challenges she faces can be dealt with without frustration in a positive way, that's important.
>
> I do it as I know it is right, you just do really, it's all about liking children and wanting the best for them – like you want the best for all children including your own.
>
> (*Martha, key person to Bea and Paul, by e-mail, October, 2010*)

For Bea and Paul, the support offered to them in their problem solving was individual to them, based on Martha's knowledge of their development and preferences. What is unclear, however, is what factors helped Martha build her knowledge of her key children and how much would be passed on when Bea and Paul transferred to the toddler room

and their new key person. Both areas, as chapter six outlines, are worthy of further study.

Flo

Flo aged 4 months

At four months Flo started the nursery already rolling over and 'shimmying' her body off a play mat. She protested at being in a car seat or bouncing chair and by five months her parents reported that she had overturned herself in her bouncing chair at home. Flo walked at nine months and used anything within reaching distance as an aid to standing and walking. Many of the observations made before she independently took her first steps appear to be of her involvement in exploratory play, which Bruner (1973) emphasises as being a precursor to skilled action and problem solving (Sylva *et al,* 1974). Like Bea, as Flo became mobile, there was an increase in the number of problem solving episodes recorded in my observations.

Flo at four months liked to make things move, so she would swipe her arms or kick her legs at most objects within her sight line. Flo's problem solving appeared to revolve around how to reach objects. Observations record that Flo sought help from adults by loud vocalization and crying and occasionally fixing her gaze on the desired object. With increasing control and physical coordination Flo appeared to rely less on seeking help from others and more on determination and persistence.

Flo aged 1 year 2 months

Most of the problems encountered by Flo, as an older child, came from her attempts to move around, on and over fixed objects as observation 72 illustrates. Observation 72, I would suggest, is a good example of Flo using her newly found mobility both to create problems and to solve them.

Box 5.11: Observation 72: Flo aged 9 months retrieving objects that she has posted behind the sofa in her nursery

Ref Ob. 72F June, 2010	Observation 72 Abbreviations: Flo (F) aged 9 months M (locum early years practitioner) Problem: Retrieving an object that Flo has posted behind the sofa in her nursery I am standing next to the wall of the baby room	Coding Problem Elements of p/solving Children's main p/s ways KP support Sweeper category
Timings		
9.54	Observation starts 9.54 F is standing upright on the sofa with baby board-book in her right hand. She drops the book between the sofa and the wall Looking down at the gap where the book was dropped F crouches down and picks up another board-book from the sofa and holding it by the front cover (pincer grip?) drops the second book behind the sofa. F looks and stretches her right hand behind the sofa she crouches down, sits on her bottom, leans to her right and slides off the sofa feet first	
10.10	F adjusts her balance by holding on to the arm of the sofa and moves to the left of the sofa to move around the low level book case F holds on to the middle shelves. Once clear she takes three independent steps to reach the wall and the back of the sofa, sits down and gazes into the space behind the sofa F retraces her steps back to the sofa, falls front first on to the sofa scattering a pile of books F stands up by pulling on to the sofa covers and attempts to lift one leg on to the sofa – overbalances. F continues to pull on to the sofa attempting to lift her right leg on to the sofa.	Plan? Do?

	M walks over to F and lifts her away from the sofa 'you are not to climb, you will fall, and cry' M, noticing the pile of books, offers to read F a story, which she does, with F sitting by her side on the sofa	
10.25	Observation ends 10.25 <u>Discussion</u> I leave the baby room to talk to Julie the nursery manager in her office. On returning to the baby room at 10.30 I see F lying on the top of the sofa, balancing with her tummy wedged between the sofa and the wall – no one is quite sure how F has managed this. F is pointing towards the gap between the sofa and the wall.	

Observations show that once she was upright and mobile, her problem solving centred on moving around furniture and, later, once she became more mobile, on moving from A to B in search of an object. Other observations capture Flo visually scanning the room, moving her head and turning her body around. During the first two months in the main study, Flo seemed to have worked out a safe route around the room to the shelf where colourful toys were kept. As she became more confident she explored different routes. Often, this involved manoeuvring around items of furniture, such as the sofa, and play equipment such as a large sand tray. Britney, Flo's key person, noted that on the days when the sand tray was used or when the sofa was moved elsewhere in the room Flo restricted her walking.

Bruner (1973) observed similar patterns of behaviour and suggests that children under eight months deliberately restrict their movements when attempting to master a new skill. As each component of the skill is mastered the child's self imposed restrictions are progressively relaxed so that the new methods are incorporated - excellent energy efficiency!

Towards the end of the main study, observations record Flo successfully navigating around and up and down large objects, a skill she later refined in the last month of the main study when riding a push-along trike and manoeuvring around obstacles.

One of Flo's early navigational strategies was attempting to climb over furniture, which seemed to be an extension of her fascination with going over and under, a possible schema (Athey, 2007). Two observations were made of Flo climbing over the sofa during one morning session. These observations perhaps illustrate the overlap between exploratory behaviour and problem solving. Flo was certainly exploring how to move her body effectively but was Flo achieving a planned goal in observation 72 (i.e. to climb on the back to the sofa to reach a book) or was the reaching the back of the sofa a consequence of her climbing? On both occasions on reaching the top of the sofa, an adult lifted Flo down and explained to her why it was dangerous to climb on the sofa. However, this explanation was obviously not sufficient as Britney, Flo's key person, commented on my next visit to the nursery that Flo was continuing to climb over the sofa and that this seemed to offer her endless fascination. So, was this new activity exploratory behaviour or an episode of problem solving which literally entailed the circumvention of obstacles to achieve an objective, Muir *et al*'s (2008) definition of problem solving?

In what ways did Flo's key person support her problem solving?
Observations show that Britney ensured that Flo was safe during her many problem solving adventures. This was achieved by removing equipment to prevent tripping, lifting Flo off pieces of furniture on which she was precariously balanced, reminding Flo of the consequences of her actions and providing alternative ways of achieving her goal, such as asking for adult help to reach a toy on a high shelf. Britney also stated that she ensured that the baby room in which Flo was based contained 'safe' toys that she could explore. These were changed each week to offer variety. Materials such as sand, water and playdough were introduced to Flo as an older toddler that offered new problems to be solved.

Discussion of Flo's problem solving

Risk taking

Risk taking, alongside persistence, is considered by some researchers to be a characteristic of successful problem solving (Schweinle *et al*, 2006; Middleton and Spanais, 1999). However, the level of risk appropriate for very young children is difficult to define. There is debate about stifling resilience in children by taking an over-protective approach to their health and safety (Gleave, 2008). Gill (2007), for example, argues that taking risks can have positive implications in terms of children's developmental, social and emotional needs as well as their overall health, and that eliminating risks deprives children of the opportunity to assess them:

> so they are left unequipped to deal with any situations they may need to deal with in later life. (p. 12)

In the arena of problem solving, Dweck (2000) suggests that embracing risks and taking an 'I can do attitude' are important characteristics of effective learners. Dweck (2000) goes on to argue that such traits are not biologically determined but result from the attitudes of adults around children.

Very young children are physically vulnerable to harm and early years practitioners have a duty of care. But how does this equate to promoting and supporting risk taking behaviour in their problem solving? Although Lindon (1999) suggests a range of factors that risk assessment should take into account – such as the environment, the setting's purpose, the children's abilities and maturity – she concludes that 'educated judgement still plays an important role in risk assessment' (p. 5).

Exploratory play and problem solving

When observing the play of the youngest children, a recurring difficulty lay in differentiating between exploratory play and problem solving episodes. The analysis framework adopted was compatible with the actions of children over one but not so useful when reviewing the play of children under one. As already noted, infant research (Evangelou *et al*, 2009) is now showing that babies can behave as it they know how to solve

given problems (and the rules by which to do this) but it is impossible as yet to tell how conscious this learning is.

Keen (2011) maintains that although there is evidence to suggest that exploratory play comes before problem solving (Davies, 1995), it is perhaps more accurate to see both as overlapping. As previously documented, Hutt (1966) distinguishes between exploratory behaviour and investigation and concludes that exploration involves inquisitiveness and that the investigation is determined by the nature of the object, the goal being 'getting to know the properties' (p. 211). Although Bruner (1973), in common with Gopnik *et al* (1999), draws on evidence that indicates that, from birth, children have the capacity for both exploration and problem solving, as Bourgeoise, Khawar, Ashely-Neal and Lockman (2005) note, it is unclear where the overlaps are. Certainly, isolating the point at which exploratory play became problem solving, for me as researcher, was unclear. This in part, as discussed in chapter six, may be attributed to my use of an analytical framework that was not sufficiently refined to accommodate exploratory play as defined by Hutt *et al* (1989).

Rosie

Rosie aged six months

Rosie appears to enjoy the company and closeness of her key person Tina. Observations show that Rosie often seeks assistance from Tina by handing her objects or banging objects together to arouse Tina's attention. Pointing is also becoming Rosie's preferred mode of communication, accompanying this with smiles, head nods and utterances to marshal assistance from Tina.

Observations also show that many of the problems that Rosie sought to solve arose from her desire to reach objects. Her gaze often indicated the desired object, followed by movements such as arm waving and, later, leaning forward from a sitting position. Persistence was evident, as well as what Atkinson (2000) describes as 'visual attention' – the ability to 'fix and follow' objects visually (p. 107). As with Flo, who is a little younger

than Rosie, most problem solving appeared to revolve around how to reach objects using body movements as illustrated in observation 12.

Box 5.12: Observation 12: Rosie 6 months reaching for the yellow bird

Ref Ob.12/R March 2010	Observation 12 Abbreviations: Rosie (R) aged 6 months T (T) KP Problem: Reaching for the yellow bird I am sitting on a low chair watching R and T. R has just woken up from her morning nap	Coding Problem Elements of p/solving Children's main p/s ways KP support Sweeper category
Timings		
11.20	Observation starts 11.20 R is lying on her back swinging her left hand towards the yellow felt bird suspended on the overhead mobile, a lengthy periods of gazing is followed by vigorous arm waving	Problem?
11.23	T detaches the yellow bird and holds it with within reach of R's arm waving T lies down next to R. B is smiling and cooing at R who switches her gaze between the bird and T's face	
11.25	R continues to swing her left arm towards the yellow bird. This action is repeated ten times. R's gaze is now fixed on the yellow bird	
11.27	T lifts R on to her lap facing forward and moulds R's hand around it. R lets the bird slip, and, appearing to lose interest, brings her left fist to her mouth and a period of sucking on her fist begins	Guided action (plan, do review?) Modelling grip?
11.28	Observation ends 11.28	

Rosie aged 1 year 4 months

Following a lengthy four month absence from nursery Rosie returned to her nursery being able to crawl. This opened up new possibilities for problem solving and observations record her fascination in moving around the room and squeezing herself into small spaces, such as the gap between the sofa and the wall and moving through, over and under play tunnels and slides. Rosie also is able to reach out and grasp objects in a more coordinated way. She is selective about choosing objects to play with.

In what ways did Tina support Rosie in her problem solving?

The emotionally warm responsiveness between Rosie and Tina that Evangelou *et al* (2005) describe in terms of 'contingent responses' (p. 4) was striking. Discussions with Tina during the main study period illustrated that she knew Rosie well and was able to interpret her body movements, gestures and vocalisations, often anticipating ways in which support is required. This 'tuning in' can be difficult, as Lancaster (2003) acknowledges. However, Tina constantly listened and watched her key children and made herself physically available to them by sitting on the floor with them or on a low chair. In return, Rosie was confident that help could be gained from Tina. Tina described herself as 'not much of a chatter box with the children'.

Reciprocity between Rosie and Tina seemed to occur on two levels. First, when Tina anticipated Rosie's need for help in problem solving episodes by responding to her body language, facial expressions and vocalisations and therefore pre-empted possible requests and frustrations. Second, by Rosie who guided Tina, through use of gestures, babbling, smiles and shouts of frustration. This relationship shows that supporting children's problem solving goes beyond supporting their cognitive development and the adults' role of the knowledgeable other. However, it does not seem to encompass collaborative learning, which Siraj-Blatchford (2007) sees as one of the underlying principles that underpin sustained shared practice.

Discussion of Rosie's problem solving

Of the three principles that Siraj-Blatchford (2007) highlighted as underpinning sustained shared thinking, collaboration is perhaps the least well defined. Dillenburg (1999), in the context of collaborative learning, writes of the difficulty in agreeing a definition but offers the following:

> If peers are more or less at the same level, can perform the same actions, have a common goal and work together. (p. 7)

Although Rosie is cared for within a group of children, her interactions with her peers occur not in her play but during routine events such as mealtimes. In effect without the support of Tina, Rosie appears to function in her play in her own world, reflecting the egocentricity identified by Piagetian theory (1953) in which the infant child is unable to understand the relation between its own activity and any effects that arise from that activity. However, as David (2003) point outs, research indicates that collaborative activities appear to be very important for children in the early years. David (2003) also draws attention to the role of talk as a social model of thinking and as a means of intellectual stimulation and development, not just a means of communication. Although Rosie benefits from her interaction with Tina, the central question emerging from my observations of Rosie, as with all the other nine children, concerns the lack of opportunities for her to interact with her peers and indeed older and more able children in her nursery to facilitate collaborative learning.

Needham (2010) in his studies of children's learning from early infancy onwards highlights collaborative working with older peers as a key indicator of effective learning. However, Rogoff *et al* (2003) indicate that there is an argument to be made for a balance to be achieved between, on the one hand, reciprocal, independent and collaborative adult-child learning and, on the other hand, learning between children to stimulate the full range of cognitive skills (Azmitia, 1998).

My observations record that during their nursery day many children under two years received one-to-one attention from their key person. These

interactions, although emotionally warm, appeared occasionally not to take account of the young child as a powerful and active learner with autonomy and agency. In this light, problems arising from the children's play were either anticipated and removed or resolved without involvement of the children. Some children therefore occasionally became passive and over-reliant on their key person. Consequently, their problem solving became what I describe in my research journal as 'diluted'.

The motivational value of allowing learners to develop a sense of ownership has been identified as enhancing learning, promoting what Robson and Fumoto (2009) describe as authentic understanding and reasoning 'that can shape actions and develop a sense of autonomy' (p. 44). Where conditions do not allow for this ownership to develop, Lowrie (2002) argues that confidence in personal abilities is adversely affected and intrinsic motivation is reduced. Schweinle *et al* (2006) in their observations of classroom environments concluded that where teachers control behaviours too closely the 'emotional tone' of the classroom can become negative and children are more likely to become disengaged from their learning.

Very young children (like adults) need time to watch and listen, time for cuddles and chats and sometimes, simply, time to rest in the arms of a familiar adult. However, the issue here is that in the nursery environment there may be a fine line between adult planning of routines and activities for individual key children and stifling children's ownership of their own learning. For some children, such as Rosie, the key person system offers what Goldstein and Jackson (1994) describe as the 'emotional anchorage' (p. 101), which promotes her confidence to play and learn. However, it is an exclusive relationship, situated in a relatively isolated room in Rosie's nursery where the emphasis is on children as individuals rather than as part of a group. Although there are advantages to this, does an exclusive key person relationship impact on the development of collaborative learning between very young children?

This, I suggest in chapter six, is an area worthy of further study, considered alongside the potential benefits of mixed age grouping of children under three, an issue arising from the observations made of George and his older friend Thomas. This is relevant to some children such as Paddy, a contemporary of Rosie, who enjoyed a close relationship with his special key person Cheryl but, like Rosie, came into contact with no older children during the course of his nursery day.

Paddy

Paddy aged 6 months

Paddy's parents described him as the light of their world, clever and funny. Paddy and his family took frequent holidays to visit relatives in Kashmir and on return to his nursery Cheryl, his key person, stated that he liked to take his time to readjust to nursery life. Paddy appeared to like to watch the nursery environment rather than participate in its activities. His key person Cheryl felt that Paddy, visually alert and attentive, preferred the world to come to him rather than to explore it independently. In the later stages of the main study Cheryl noted that even with increasing mobility, Paddy preferred to remain on the play mat that was situated within easy reach of a selection of toys. Observations record that Paddy had a lengthy morning nap and on waking liked to snuggle into his comforter (a white blanket) on Cheryl's lap. Many of the problems that Paddy faced at six months involved reaching and grasping toys and making his wishes and preferences known to Cheryl.

Observations made of Paddy as one of the youngest children in my study record his developing skills in reaching and grasping objects. These observations were supplemented by Cheryl's observations. She had observed that Paddy at around the ten-month stage adjusted his handgrip to hold a beaker and later a feeding spoon. This skill of manipulating the two objects (the beaker and spoon) she thought was being transferred into his play as he enjoyed picking up small objects and posting them into containers. Paddy not only adjusted his grip to overcome the problems of picking up differently sized shapes effectively but also posted the different

shapes into the correct slot in the shape sorters, rejecting ones that Cheryl asked him to try out 'just to check if they fitted'. In observing Paddy's movement Cheryl deduced that he was able to plan and carry out a sequence of actions to achieve an objective, linking physical activity with cognitive development. Davies (1995) claims that the link between the growth of physical activity and of cognitive development remains, but that it is 'unexplored and untested' (p. 49) despite the findings of earlier research of Bruner (1973) linking cognition development to the guided action of babies.

Paddy aged 1 year 4 months

In the later stages of the main study, observations record that Paddy preferred to remain on the play mat, which was situated within easy reach of a selection of toys. His favourite activity was sitting on Cheryl's lap sharing a book with her, which he was content to do for lengthy periods. Observations made of this session record how Cheryl wove hypothetical problems into her story telling.

As Gifford (2010) points out, different kinds of problem solving scenarios can provide children with a range of learning experiences to supplement those which occur spontaneously in their everyday play and routines. However, Lowrie (2003) in his study of the influence of authentic artefacts on supporting children's problem solving makes the case for adult-initiated problem solving situations to be open-ended in nature. In his research with school aged children, Lowrie (2003) also advocates learning contexts that require children to make connections with their social and personal lives, arguing that this has 'positive effects on problem solving' (p. 351). The challenge for schools (and nurseries), Lowrie (2003) argues, is to establish a learning environment that introduces children to personalised learning in ways that allow individuals to extend, revise and make connections in a context 'that they can place themselves within' (p. 352).

In what ways did Cheryl support Paddy in his problem solving?
Observations show that Cheryl provided Paddy with a range of problems, which she felt suited his temperament. She was aware that Paddy needed the security of a known adult in the nursery and made time to be available for him. She supported Paddy's problem solving both verbally, in asking him questions to prompt a response, reminding him of earlier events, and physically in her reassuring cuddles and smiles when Paddy began to explore his immediate environment.

Discussion of Paddy's problem solving
Observations show that as a younger child Paddy appeared to be visually alert and making connections, linking his intention to reach and grasp objects with his body movements – although whether this was an extension of an innate skill or the beginning of problem solving is unclear. Atkinson (1984) evidences from her research that, by 6-9 months, infants without visual impairments are 'compulsive reachers' (p. 108) and will reach for anything within arm's length. However, after this initial compulsive reaching stage there is often a reduction in reaching as the child learns about the 'graspability of objects' (p. 108). As a result, ungraspable objects, such as a large surface or a very heavy object will not elicit a reach. As Bourgeoise *et al* (2005) explain, older babies are more selective in their use of hand grips based on their perceptions of the properties and functions of objects. This, as Willatts (1997) suggests, indicates that infants can employ a simple type of forward search for achieving a goal. Willatts (1997) maintains that this indicates a marked capacity for goal directed search in which 'random trial and error appears to take no part' (p. 39). In this context the movements of Paddy in his attempts to reach and grasp objects cannot be dismissed as random or purposeless but should be seen as part of his early problem solving repertoire.

Keen (2011) comments that with children under one it is sometimes obvious that problem solving is occurring from the perceptual features that they display. In the light of this it is necessary to pay close attention to kinetic movements, movements of the hand and arm, for example, to

draw conclusions about infant's goal directed behaviour (Adolph and Berger, 2006). However, Willatts (1990) concludes that:

> We need more research into the range of newborns' goal directed activity, better descriptions of the information infants use to guide their search and above all detailed accounts of the ways infants come to achieve their goals over successive attempts. (p. 61)

Twenty years later, Goswami (2010) confirms that research is still only just beginning to understand the various cognitive systems that guide infants' responses to events; the challenge now is to explore the interplay between neurodevelopment, cognitive systems and the social world.

Summary of the issues arising from the research findings

My main field study observations suggest that children under three pose and solve problems. Initially they use ways that appear to be uncoordinated and random but, nevertheless, are goal-directed. As the children mature, often marked by their increasing mobility, it becomes easier to identify episodes of problem solving.

Frequently used problem solving methods within Siegler's (2005) classification

Frequently used problem solving methods within Siegler's (2005) classification:

- **Manipulation of materials** – including dismantling, adjusting one part, vertical movements and rotation
- **Marshalling assistance from others** – not necessarily their key person - by gazing, gesture, crying, loud babbling smiling, pointing, standing next to adults and using words requesting help, relying on adult interpretation of these words
- **Use of tools** – such as spades, buckets, scissors, string and brute force
- **Making connections** – with enveloping/containing, dynamic vertical and rotational schemas as well as recognising cause and effect and links with mathematical concepts such as shape, space, and measures

However, categories often merged together and adaptations and deviations constantly occurred. Although I classified some of the children's approaches to problem solving as 'trial and error', in hindsight a more

accurate description would encompass Siegler's (2005) classification, which includes 'inconsistent patterns of generalization and other complexities' (p.770).

Children's abilities to solve problems

Sometimes the children work out their own solutions. Sometimes they need help from a knowledgeable other. Often for children under two the knowledgeable other is the children's key person. However, unfamiliar adults and, in one instance involving a child over two, an older friend, are also approached for help. Rogoff (1994) observes that very young children do not always stay with a trusted adult or watch activities, or get involved in, or attend to, any instruction that the adult provides. The child determines the extent of involvement. This is an important statement. Although adults may adjust their interaction to engage with the child, it is the child who makes the decision to be involved.

Key person support of children's problem solving

The children's key person used a range of methods to support problem solving including modelling solutions and verbal instructions. Feedback was infrequently used, although a lack of feedback did not appear to hinder the children. Siegler (2006) argues that adult feedback from an adult who is familiar with a child's pattern of learning generally promotes strategic thinking and is invaluable in the development of self explanation, where one 'attempts to explain to oneself the causes of events' (p. 775). Siegler (2006) further concludes that children who are offered feedback both learn and remember effective strategies better than their peers who do not seek or are not offered it. Although Siegler's (2006) conclusion is gained from his research with older school aged children, the principle of feedback merits discussion in the early years sector.

As noted earlier, aspects of the emotional support provided by the children's key person fell outside the sustained shared thinking framework (Siraj-Blatchford *et al* 2002) and were allocated to a 'sweeper category'. This did not reflect the importance of their role in supporting children's

problem solving and is an acknowledged limitation of the use of sustained shared thinking (Siraj-Blatchford *et al*, 2002) as an analysis framework,

Offering emotional support, which I classified as the '3 Cs' – 'cuddles, cues and consistent nearness' - was important when supporting children's problem solving. Many practitioners saw this as 'intuitive practice', although the same practitioners who 'tuned in' (Selleck and Elfer, 1997) to their key children, being sensitive to their needs and learning styles, offered support that went beyond 'watching' and 'helping when necessary'. During these periods of adult support, aspects of learning dispositions (Claxton and Carr, 2004) were encouraged and developed.

However, although helping children to develop independence skills and be independent learners was seen as important, what appeared to be an over-protective attitude to children's risk taking and a premature intervention to defuse potential frustration resulted in a diluting of the challenges of problem solving. Acknowledging that children have 'ownership 'of their problems and potential solutions appeared to be overshadowed by the desire to ensure that children were successful in their problem solving, resulting in practitioners taking over problems.

Organisational factors within the nurseries influence how very young children's solving is developed and supported. These include very young children's access to outdoor areas and opportunities to play alongside older and more able children. Perceived limitations of working within the EYFS (2008a) also impact on the range of opportunities offered to children to solve convergent and divergent problems.

The early years practitioners involved in the main study enjoyed reading the detailed observations of the children's problem solving. However, most of them felt that carrying out observations of this kind was not possible in everyday practice. At the beginning of my study, those practitioners involved acknowledged the capabilities of the children's problem solving in general statements (Box 5.2).

Box 5.13: A nursery manager's view of very young children as problem solvers

> 'Our children solve problems all the time, they do it all the time, I would describe them as real problem solvers'.
>
> *Julie, Nursery manager, March , 2010*

This acknowledgement however, was not often shown in the children's assessment record or in describing what the children were good at. Children were often described as 'good walkers' or 'good talkers' not 'good problems solvers'.

The contribution of my study has been to draw the attention of the early years practitioners with whom I have been privileged to associate, to problem solving as a key area of very young children's development and learning. It has helped these practitioners to recognise and discuss problem solving, to use the appropriate language in discussing it and, thereby, to capture and develop the problem solving ability of the very young children in their care. Issues arising from these discussions are presented in the next final chapter, chapter six: Evaluation and reflection.

Chapter Six

Evaluation and reflection

Introduction

My study shows that very young children are already problem solvers and that the ways in which they exhibit this ability are varied and individual to each child. In showing the ten children 'at work' solving problems, my study captures this uniqueness. At the same time it captures some of the features which the children have in common, including the age-related variations, from the more organised strategies of the older children to the more random but still effective approaches of the younger ones.

Was the purpose of my study met? I would maintain that the main study observations, although not yielding the same density as Siegler's (1996) microgenetic research methods, nevertheless provided sufficient data to show the main ways which the children used in their problem solving, addressing my first research question.

The scope of my research was wide, as it included an exploration of how the children were supported in their problem solving in their nurseries by their main carers – their key person. Through observation of the children and discussion with their key person, I have been able to uncover the wide range of support provided by the practitioners. This includes what they called 'intuitive' support, encompassing the nurturing of the children's cognitive skills and helping to meet their emotional needs. This has raised issues for further discussion, rather than provided a definitive guide about 'how best to support the young problem solver'.

Strengths of my study

The observations arising from my study build on to Lambert's (2000) research in that they show that young children solve a wide range of problems that they encounter in their everyday lives. My research highlights the often open and inconclusive nature of problem solving (Taggert *et al*, 2005), which adds to the difficulty of determining precisely what problem solving is.

Rather than accept that promoting and supporting children's problem solving is a 'stubbornly hard nut to crack' (Rogers, 2004, p. 24), my study attempts to define its characteristics and how these can be used to identify and analyse very young children's problem solving episodes, particularly in their play, which Sylva *et al* (1974) see as an ideal medium in which children can explore, investigate and solve problems. In my incorporation of Siegler's (2006) research I acknowledge the nature of problem solving as a complex series of overlapping skills and approaches. This adds still more to the difficulty of determining what problem solving actually looks like in practice.

Building on observational data gained through an ethnographic approach, my study sustains the concept of the young child as a capable learner (Gopnik *et al*, 1990). It also justifies the use of children's nurseries as a research location in a field which is dominated, I would argue, by cognitive research projects carried out in laboratory settings. In adopting the ethnographic approach I had, of necessity, to devote time and effort to forming respectful relationships with the nursery staff, the children and their families, and to addressing and being alert to the ethical issues before, during and after the study period. However, this careful preparation and conduct of the relationships meant that I was able to observe the children in their nurseries and thereby to see them in the social context which exerts a strong influence on their approach to problem solving.

By focusing on the role of the children's key person my study draws out aspects of their support for children's learning. My observations have recorded the warm emotional closeness of the child and key person relationship and the reciprocity between them. This reinforces the already known benefits of the key person system (Elfer *et al*, 2003) and its impact on children's learning and development (Evangelou *et al*, 2009).

Research into children's development as problem solvers has indicated that support for the emotional elements of learning – motivation,

confidence and the willingness to take risks (Whitebread, 2011, Lowrie, 2003, Lambert, 2000) - is important. In this light, the role of the key person is heightened, as are the key person's ability to provide an emotionally secure base from which children are able to respond to the challenges of problem solving.

Limitations of my study

As documented in chapter four, I acknowledge the limitations of the use of sustained shared thinking (Siraj-Blatchford, 2002) as an analytical framework. Wellington and Szcerbinski (2007) point out that during analysis there will be new kinds of data - the sweeper miscellaneous category - requiring new thought and new categorisation. I had to create this category in order to incorporate the elements of emotional support given to the children by their key person. This was extensive and did not align with my use of the sustained shared thinking framework. My initial planning for data collection could have given a higher priority to these aspects.

Additionally, as the focus of my observations was on the activities of the children themselves, insufficient time was spent recording and considering the impact of the social environment of the children's nurseries on their problem solving behaviour and on how it is supported. Unravelling the social elements entails being present in order to capture the nuances and complexities of the relationships. This may well suit 'action research', which is usually undertaken by a person who is both researcher and practitioner/user (Wellington and Szczerbinski, 2007, p. 214). A research practitioner, through being close to the everyday nursery events that surround the children, may be more successful in teasing out these social influences. However, the freedom from everyday duties, which my status as a non-participant observer offered was helpful in developing what Cohen *et al* (2007) describe as 'researcher awareness' encompassing:

> Adaptability, responsiveness, knowledge, ability to handle sensitive matters, and ability to clarify and summarise – 'to see the whole picture' (p. 140).

Contribution to existing research and an identification of areas that warrant further study

Part of seeing the 'whole picture' is considering how my study has contributed to existing research. My study has raised issues about the opportunities given to children to extend their problem solving ability, particularly in respect of access to outdoor areas for children under two, and about organisational factors that appear to inhibit effective support.

In highlighting these, my study endorses and reinforces the findings of previous studies. Here, the following areas are already well researched and their importance is widely recognised:

- The practitioners' perceptions of constraints placed by the Early Years Foundation Stage curriculum (DCSF, 2008a) on the planning and delivery of adult-led problem solving activities
- Over-reliance on some methods of adult support within the sustained shared thinking framework
- Attitudes to risk taking in children's problem solving behaviour

Areas arising from my study that need further exploration in the light of existing research findings are:

- How information about children's problem solving is passed on when children are transferred to a new key person
- Limited access for children under three to outdoor areas
- Potential benefits of mixed aged grouping on the development of problem solving skills of children under three

These issues are discussed below.

How information about children's problem solving is passed on when children are transferred to a new key person

As previously discussed, many of the childcare practitioners involved in my study felt that there was insufficient time to observe and record the activities of children. As a result, the knowledge about the approaches the

children used in their problem solving was known (or sensed) by their key person but not necessarily recorded. In all three nurseries, as children transferred from the baby room to the toddler and, later, pre-school room, a new key person was allocated. Systems to pass on the information about children's learning were in place in each nursery, usually as a child portfolio. However, these portfolios often contained one or two observations (and accompanying evaluation sheets) – but they did not appear to capture the children's interests or preferred ways of learning. As Poplur (2004) notes in her study of practitioners' use of schemas to promote young children's development most practitioners resorted to sharing information about the children amongst each other verbally.

However, time for information sharing appeared to be limited. Although all three nurseries 'ring fenced' time to allow staff to meet during the nursery day, this was often eroded to cover staff absences. It also appeared that agendas for out-of-hours staff meetings concentrated on health and safety issues, event planning and discussion of national early years initiatives, a tendency that Fenech and Sumsion (2007) see as a consequence of an over-regulated childcare system.

As a result, my study indicated that the detailed knowledge that each key person possessed about his or her key children, a feature of the key person system (Elfer *et al*, 2003), was not always adequately passed on. Consequently, continuity in the adult support of children's learning, not just their problem solving, was lost, which in part justifies Penn's (1977) claim that, organisationally, the key person system does not work in practice. However, this is counterbalanced by research that illustrates the impact on very young children's (and practitioners') well being when the key person system receives effective organisational support (Elfer, 2007; Elfer and Dearnley, 2007).

<u>Potential benefits of access to outdoor areas on very young children's problem solving</u>

The benefits for children of being outdoors, as Evangelou *et al* (2009)

acknowledge, are well researched and publicised. The children have space to explore, investigate and engage in spontaneous problem solving. Within my sample of ten children under three years of age, three had free-flow access to indoor and outdoor areas and two children over two had daily timetabled access. However, the remaining five children, all under two, did not have daily access to an outdoor area. Consequently, they did not encounter the range of problems that being outdoors offers, as Lambert (2000) documents in his research. In the light of my observations, the three nursery managers are reviewing the use of the outdoor areas for children under two.

Another area that the three nursery managers felt was worthy of review was their grouping of children in same-age year groups. The nursery managers recognised that this practice did not provide children under three with the potential benefits associated with mixed aged groupings (Clare, 2008).

Potential benefits of mixed grouping on very young children's problem solving

Throughout my main study, the observations of George and his older friend Thomas illustrated the benefits of younger and older children working together to solve problems in terms of knowledgeable support (Clare, 2008) and companionship (Trevarthen, 1979). There is a large body of research to suggest that the effect of mixed aged grouping on very young children's development is beneficial (Clare, 2008; Manion-Fleming and Alexander, 2001; Azmitia, 1998; Manion and Alexander, 1997; Katz, Evangelou and Hartman. 1990).

However, as Katz *et al* (1990) point out, this is not to suggest that random mixing of children of different ages will have guaranteed benefits on their children's problem solving ability. Influential factors such as the proportion of younger to older children, accommodation, resources and how best to support a range of abilities, need to be taken into account.

Research indicates that very young children are not only very aware of each other but for much of the time 'are engaged in active interchanges' (Goldschmied, 1987, p. 102). However, in nurseries, such as the three establishments involved in my main study, which care for children under two in rooms separated from the rest of the nursery, the potential for younger child/older child collaborative learning is not fully exploited. Again, the creation of opportunities for younger children to be with older children is an area that all three nursery managers thought needed review.

My observations have prompted a review of practice in all three nurseries involved in the main study. They have also indicated that the following areas would merit further study:

- The value of treasure basket play in developing problem solving skills
- The potential for supporting young children's problem solving with reference to their preferred patterns of thinking/schema
- Defining what practitioners mean by their use of their 'intuitive' support for children's problem solving

The introduction of problem solving treasure baskets

Nutbrown and Page (2008) acknowledge that early years practitioners have continued to adapt the use of treasure baskets to offer different learning opportunities for children under two. Observations of Bea and Paul's treasure basket play indicate that problem solving skills associated with manipulation of objects and making connections were practised and developed in an environment where all learning dispositions (Claxton and Carr, 2004) flourished.

Although I am reluctant to follow the path of Goldschmied and Jackson (2004) in prescribing specific designs and contents of 'problem solving treasure baskets', it can be argued that the very nature of the treasure basket, with its wide range of everyday resources, offers a varied diet of potential problems to solve within the reach of very young children who can sit but not yet crawl. With reference to heuristic play for older, more mobile children, Goldschmied and Jackson (2004) state 'that it has been

calculated that four bags each containing 60 items allow for the possibility of 13,871,842 combinations!' (p. 136).

As previously discussed in chapter five, I maintain that in the use of treasure baskets, very young children who can sit but not yet crawl potentially have the freedom to explore, albeit in rudimentary ways, what Thornton (1995) describes as 'the dynamics of solving problems' (p. 63). Nutbrown and Page (2008) maintain that 'the learning experience is even more powerful' (p. 151) when practitioners are 'tuned into' (Selleck and Elfer, 1997) young children's learning. I would maintain, in agreement with Athey (2007) that this powerful learning experience is also present when account is taken of children's schema development.

Using children's patterns of learning in support of their problem solving

The wide range of methods that children use to solve a problem suggests (as neuroscience and cognitive research is confirming) that problem solving involves, to varying degrees, intuitive and purposeful action. In their summary account of children's problem solving, Siegler and Alibali (2005) state that problem solving involves orchestration of a large number of processes. I would (tentatively) suggest that for young children this process includes patterns of learning, which Athey (2007) describes as schemas.

There are many advocates of the potential benefits of supporting and developing young children's schemas (Atherton, forthcoming; Meade and Cubey, 2008; Athey, 2007; Atherton, 2004; Nutbrown, 2006; Manning-Morton and Thorp, 2003). Action research such as Poplur's (2004) also illustrates the benefits of supporting young children's schema. Poplur (2004) concludes that adult recognition of children's schemas empowers them to follow their own learning agendas, with the support of 'intellectually satisfying discussion with adults' (p. 120).

Ten observations during my main study period indicated that when the

children's key person tuned into (Selleck and Elfer, 1997) the children's patterns of thinking or schema (Athey, 2007) and offered support that utilised this, the children's periods of problem solving were lengthy and the children appeared to show sustained interest. This, I feel, is an exciting concept and certainly worthy of further study, as is unpicking what the early years practitioners in my study called their intuitive support of children's problem solving.

Exploring what constitutes intuitive adult support of very young children's problem solving

My study demonstrates the role, highlighted by Elfer *et al* (2003), which the children's key person played in providing emotional support for the children. This was present throughout the main study period. Elements of this emotional support, which I describe as the '3Cs'gave both the 'green light' to problem solving – 'it's ok to problem solve' - and provided sanctuary when problems became overwhelming.

The importance of emotional support in very young children's lives is widely acknowledged (Evangelou *et al*, 2009). However, the practitioners involved in my study often described their emotional support of children as 'intuitive'. As chapter five documents, I suggest that what is described by practitioners as intuitive support is based on their knowledge and understanding of the personal traits of their key children, which Selleck and Elfer (1997) see as part of the process of tuning into children. Belsky (2007) sees this tuning into children as stemming from sensitive and responsive care, when the caregiver attends to a child's needs rather than their own. Lee (2006), however, argues that tuning into children is a more complex process. In his multi-method study into the relationship of babies with their significant adults outside the family, Lee (2006) suggests that reciprocity is significant in forming a mutually meaningful relationship, in which both the child and the adult are co-constructors, 'each seeking the other out' (p. 156). Exploring these differing interpretations may help to define 'intuitive' support and influence its development. As the research of Robson and Hargraves (2005) suggests, this exploration may prove to

be illuminating, not only to the practitioners themselves but also to those who support and train them.

Concluding statements

Very young children solve problems every day. Sometimes they employ relatively crude methods - such as brute force - and sometimes more sophisticated ones - such as the use of tools. That the nurturing and development of children's problem solving is important is well supported by research (Taggart, 2011; Taggart *et al*, 2005). Whether it is currently used as a vehicle for further learning remains questionable.

Problem solving under the umbrella of 'thinking skills' is already incorporated in the national curriculum framework (QCA, 2000), in initiatives for primary school aged children (Thinking Actively in a Social Context (TASC), Wallace *et al*, 2002) and for secondary school aged children (Cognitive Acceleration Through Science Education (CASE) Adey, Shayer and Yates, 1995). More importantly, the promotion of thinking skills, incorporating problem solving, is being made more explicit in future early years curriculum frameworks (Department for Education (DfE), 2011, p. 27)

There can be no doubt that problem solving and how it is supported is important. As Smith (2004) writes, when problem solving is seen to be underdeveloped in adults' lives there is amazement that insufficient attention has been paid to its promotion in children's education. Claxton (2004) adds that in an age of uncertainty the only useful - and defensible - thing to do is to attempt to prepare future generations to deal with it. Surely, fostering and nurturing children's abilities to solve problems must be part of this preparation?

In agreement with Robson and Hargreaves (2005), I suggest that early years practitioners need to be:

> Actively working to develop children as autonomous, flexible and creative thinkers, equipped with the reliance and resourcefulness to deal with uncertainty. (p. 92)

Furthermore, as Robson and Hargreaves (2005) conclude, 'this is a vital and achievable goal for early childhood practitioners' (p. 92).

Young children have what Nutbrown (1996) so vividly describes as a capacity for 'uninterrupted, unthwartable and multidisciplinary learning' (p. 44). Research, documented in this thesis and my observations, confirms the abilities of children under three as capable problem solvers. I suggest that future discussion about very young children as problem solvers must focus on how problem solving is supported as a vehicle for their learning. This discussion needs to include the means by which it is supported as a series of cognitive skills, and by which it can be made to reflect and be attuned to children's learning dispositions (Claxton and Carr, 2004) and their emotional needs.

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Appendix 1

Letter confirming the agreement of ethical review

The University Of Sheffield.

The School Of Education.

Kim Wall ng

Head of School

Professor Peter Hartley

15 January 2010

Telephone: +44 (0114) 222 8096

Dear Kim

Re: Children under three as problem solvers and the role of their special adults.

Thank you for your application for ethical review for the above project. The reviewers have now considered this and have agreed that your application be approved.

Yours sincerely

Jacquie Gillott

Mrs Jacquie Gillott
Programme Secretary